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A BASIS OF INTERNATIONAL CO-OPERATION

IN preparing for the new world order to be established after the War, we must clearly draw whatever conclusions we can from the experience of the last twenty years, seeking to embody the lessons we learnt in the constructive effort of framing a new peace settlement. The truth that nothing short of an economic revolution can give us security has been emphasized by many authorities of widely differing outlook, but the extent to which a foundation already exists for further constructive and creative effort is often overlooked. Notably is this true of the work of the International Labour Organization and of the non-political work of the League of Nations.

The last report of the director of the International Labour Office visualized the important contribution which the organization might make to human welfare even with the outbreak of war, and that forecast has in no way been invalidated with the removal of the Office to Montreal in view of the increasing difficulties of communication between Geneva and member States. From the quarters placed at its disposal by McGill University, as well as from the correspondence offices in London, Washington and Delhi, the organization is continuing its activities, albeit on a reduced scale, as well as assisting in surveying social and industrial changes brought about by the War. Not the least valuable of these activities are the admirable series of publications, including the *International Labour Review*, the *Industrial Safety Survey*, the "I.L.O. Yearbook", and "Yearbook of Labour Statistics", as well as further studies and reports, the issue of which is now to be resumed from the new home at Montreal.

The practical value of the work of the International Labour Organization in preparing peace, emphasized by the Secretary of Labour at Washington in November 1939, has indeed been accentuated as the struggle has intensified, and one country after another has been drawn into the War. The support afforded to the policy adopted by the governing body gives eloquent proof that the organization has an essential part to play at this critical juncture in the fortunes of civilization. That function is essentially a contribution to the preservation of the common heritage of civilization.

"The future of humanity depends upon the type of civilization which emerges from this war, the kind of world institutions which are constructed after it, and the intensity of the allegiance which they command, upon the common man, upon the nature of its impact upon political ideals and upon economic and social practice, upon the manner in which it affects the crisis in social evolution which dominates our time." Nothing which has occurred has invalidated this estimate by the Director of the Office in October 1939, and the existence of this agency for disinterested technical assistance, the concerting of practical measures to limit moral and national havoc within or without the war zone, and to maintain co-operation between Governments, employers and workers represents an immense advance on the forces available for reconstruction available in 1918.

If, indeed, the International Labour Organization represents in some measure that scientific detachment without which we may well be unable to achieve some of the essential reconstruction and rehabilitation, in the non-political achievements of the League of Nations itself there are equally

sound reasons for hoping for an advance on the position of twenty-five years ago. To the value of these achievements an admirable article in the American quarterly *Foreign Affairs* by Mr. Arthur Sweetser, a director of the League secretariat, testifies. The League's own reverses, notably in the Disarmament and Economic Conferences and in the Manchurian and Ethiopian disputes, have distracted attention from its solid but less conspicuous successes. This distortion of our understanding of events since 1919 may conceal valuable clues as to the planning and rebuilding which lie ahead of us.

Mr. Sweetser rightly points out that any political institution is a reflection of the society from which it has sprung, and the League of Nations, in particular, has been a vivid expression of the period into which it was born. Its record is valuable both as an index of the stage which international life has at present attained, and as an augury of the course we may expect it to take in the future. The sharp interruption of the varied work of international co-operation carried out at Geneva for two decades, involving the cessation of conferences, drastic reduction of staff, and transfer of some of the technical services, commencing with the financial and economic, to the United States on the joint invitation of the three educational institutions at Princeton—the University, the Institute for Advanced Study, and the Rockefeller Institute for Medical Research—provides indeed a most appropriate opportunity for appraisal of these non-political achievements.

The value of such stocktaking is indisputable, for it is on the assets that remain that the new organization of international co-operation will be built. The need for such co-operation will tend to increase, not only because the ravages of war must be repaired, but also through the relentless advance of science, the continual widening search of industry for specialized materials and the growth of the world's population. Only international organization of the world's life can prevent another and even more calamitous disaster.

The impetus which the League has given to international co-operation is unmistakable. The provision by the League system of a permanent Civil Service supplied with funds and authority, and able to collect and preserve records and statistics, and to enlist and to use the services of experts from all countries, is one of the main reasons for the advances made in the last two decades in handling a wide range of technical questions, from financial and economic problems to the control of opium and other drugs and the consideration on an international scale of health, including nutrition.

Without going into the details of the League's remarkable achievements in these technical fields while international friction was reducing its effective political power to a mere shadow, they present several features which merit attention. A noteworthy part of the financial section and economic intelligence service is the provision of an admirable series of publications which give the world for the first time something of a detached scientific view of the problems covered by the section, in place of the partial or national point of view from which such matters have in general hitherto been approached. The development of this scientific approach and the introduction of something of the scientific spirit into the examination of all these technical matters well justifies General Smuts's observations in his Sidgwick Memorial Lecture. If this is indeed one reason for the success of the League in such technical fields, it may well hold a clue as to the correct approach in other fields also.

A second feature to which Mr. Sweetser directs attention is the unexpected quarters from which the stimulus leading to important advances often comes. The League's first effort in the field of nutrition was made in Japan, where an inquiry was held by the League at the request of the Japanese Government. In this work Australia has taken a leading part, notably through her delegate to the League Assembly, Mr. S. M. Bruce. Moreover, the committee set up under his chairmanship, and known as the Bruce Committee, has already pointed the way forward to social and economic developments of the utmost importance.

Important contributions have by no means been limited to the States members of the League. The success of the League's work in the field of opium and international health has been largely due to the co-operation of the United States. Throughout the last two decades the tendency has been for such co-operation in technical matters to increase, independently of the way in which the political situation might encourage or discourage American co-operation with the League in strictly political affairs. Experience does, indeed, suggest that the United States will be ready, after the War, to take a share in the economic reconstruction on which the hope of the recovery of Europe depends, and that there are no inherent obstacles in the League's

organization to the constructive technical and economic work which must proceed side by side with, if not as a prelude to, political reconstruction.

Another significant feature in the technical work of the League which is noted by Mr. Sweetser deserves special attention. Delegates at Geneva handling such problems are often far ahead of their Governments at home. As perhaps might be expected, not only have they a strong sense of the urgency of the problems they are discussing, but also they tend to approach them from the professional point of view, with its desire for constructive and appropriate action. This urge to obtain an adequate technical solution to such problems is reinforced by the larger perspective in which the problems are viewed, and the corporate spirit inspired by the day-to-day process of give and take.

In contrast to this, ministers and officials at home are still in a national atmosphere, subject to all sorts of inhibitions and jealousies. The narrowing of this gap, between what a diplomatist viewing the world as a whole recommends and what a local politician at home is willing and able to accept, is indeed one of the great problems facing the future.

Much is involved in any such efforts at extending the cool, serious, and detached spirit of science into national and international government. The impartial examination of the facts is only the preliminary stage, and perhaps the most elementary contribution which professional organizations, whether of scientific workers or other types of experts, have to make to social advance. A wide vision, minds imaginatively alive to the human issues involved, cool in judgment, and willing, if need be, to sacrifice position or career rather than be false to the truth as they know it, or the vision they have seen—these are first among the qualities which will build us a new and better order. The measure in which they have been revealed in many ranks of society under the searching ordeal through which we are still passing is alike a sure pledge of victory and an earnest that we shall not fail to reap its fruits for all mankind.

BIOLOGY FOR THE MILLION

The Uniqueness of Man

By Dr. Julian Huxley. Pp. xiii+300. (London: Chatto and Windus, 1941.) 10*s.* 6*d.* net.

"THE UNIQUENESS OF MAN" is a book full of good reading, very diversified and occasionally very provocative, like the mind of its author. Julian Huxley is, among other things, the natural successor to Ray Lankester, the ripe and abundant author of "Science from an Easy Chair". These papers vary in quality from the admirable essay which gives the book its title to a cheery little review of "Who's Who", which lines up with its betters as "The Analysis of Fame". Such papers as "Climate and Human History", "The Origin of Species", "The Concept of Race", and "Mice and Men", are exactly what the man of intelligence, mainly preoccupied with other work, needs to keep him up to date with his biological ideas. The concluding three papers are 'religious' and very earnest in tone.

The title paper, written for the *Yale Review*, is done with a carefulness and precision not always evident in Dr. Huxley's fluent writing. It gives an extremely good survey of the profound gulf that has opened between *Homo sapiens* and the rest of the animal kingdom out of which he has arisen in the brief space of at most a quarter of a million years, a mere moment in geological time. This gulf was cleft open by conceptual thought. Already before then the anthropoid apes were an odd outstanding group of animals descending gingerly from the trees; but although their hands were comparatively free, Dr. Huxley tells us, they had no means of transmitting and handing on ideas. Then came words. With conceptual thought man established a mental and moral continuity and a power of assimilating social groups, additional to and far more effective than the links of consanguinity and physical inheritance He developed a novelty in the history of life, "cumulative tradition", and so by means of the word he escaped from the limitations of the small churlish family group hitherto characteristic of other anthropoids. That may not be wholly true. There may have been an intervening phase before the spoken word dominated us, when man had already achieved a certain power over general ideas by means of gesture. Many peoples can still converse by gestures with words as accessories. Man may have begun with gesture and mimicry, with grunts and sounds arising out of his movements. He may have been visual in his communications before he became vocal. He may have drawn and made tally marks long before he used common nouns or numerals in counting.

It is perhaps an impertinence for a general reader to criticize the precision of a distinguished man of science; but occasionally there is a very perceptible laxity and tolerance in Dr. Huxley's phrasing and mental attitude that is not in the best scientific tradition. He says that man has acquired the possibility of a unified mental life. The work of Pavlov and the Behaviourists goes all out to sustain the idea that he is only now acquiring it; and then, lapsing from a psycho-synthetic to a psycho-analytic phraseology, Dr. Huxley speaks of "the forces of disruption". He cannot have it both ways.

Again he seems to me too ready to deal with telepathy and clairvoyance as something new and extraordinary in human experience. But has he really worried out the possibility that the mind may work at times with a swiftness that eludes observation? A friend of mine is a crossword puzzle addict. He tells me that occasionally he can take *The Times* crossword puzzle and write down the solution with scarcely a hitch. At other times he sticks, and, sometimes, even after a considerable effort, he sticks hopelessly. Now *The Times* puzzles are very whimsical and various in their clues, and guessing them means that my friend must run over a very great store of memories, associations, possibilities and alternatives, and put this and that together. There can be no telepathy by means of the printed page. His clairvoyance, I suggest, is just extremely swift clear-mindedness. He flashes to his end and the intermediate steps vanish. The rapid answers of a calculating boy probably fall into the same category of swift reactions with no record of the steps. There is no 'extra-sensory gift' in such cases, but only indications of an enormous range in the pace of our mental processes. The same individual in different phases will vary between what we call intuition and blank impenetrability. Observations on the reactions of a fly to stimuli and of the quick decisions of a frightened cat escaping from some unfamiliar enclosure confirm the idea that ganglionic and brain responses may be immensely accelerated in comparison with everyday humdrum human experience. I am still unconvinced that there is anything quasi-occult in these apparent triumphs of the human mind over the theory of probability.

Let me now hurl a final reproach at the author for his curiously unscientific indisposition to pin himself down to unambiguous statements. His concluding papers on religion are rational and right-minded. I have no quarrel with their general trend. But this is how he winds up:

"I believe that we can never reduce our principles to any few simple terms. Existence is always too various and too complicated. We must supplement principles with faith. And the only faith that is both concrete and comprehensive is in life, its abundance and progress. My final belief is in life."

Here we are supposed to cheer and disperse in a mood of edification. I refuse to do so. What does this belief in life mean? We are alive. How can we avoid believing in life? What is the alternative? Is this an assertion that, to put it vulgarly, "life is O.K. for me"? How can one accept that nowadays? I can understand the stoic's stern pride in the life within himself. I can understand the scientific worker's devotion to truth—truth with the utmost possible precision at any cost—for how can one be a man of science without that? I can understand the man whose head is "bloody but unbowed" under the bludgeonings of chance. Maybe Dr. Huxley will reply that he agrees with all that? Then why cannot he bring himself to say so quite distinctly?

H. G. WELLS.

BIRDS OF LUNDY

Lundy: Isle of Puffins
By Richard Perry. Pp. 268+24 plates. (London: Lindsay Drummond, Ltd., 1940.) 12*s.* 6*d.*

FOR five months during the spring and summer of 1939, Richard Perry lived on the island of Lundy, an Atlantic island off the coast of Devon, in order to study the birds. Day after day, and even into the deepening dusk, he watched and observed them, and in this book are gathered together his notes.

Never, perhaps, have sea birds been studied so minutely during the whole of their nesting season, and Mr. Perry shows that he possesses to an unusual degree the gift of keen and accurate observation. The sea birds most fully described are the puffin, kittiwake, razorbill, guillemot, and cormorant. There are interesting chapters on the birds of passage and on the island's history. The book is illustrated by thirty-seven photographs by Alan Richardson, and some of them—for example, those of the kittiwakes—are remarkably beautiful.

The author was able to watch the epic journeys of the young of razorbill and guillemot to the sea from their nesting ledges. I quote a graphic

passage (p. 139) on a young razorbill's first flight :

"Shortly after nine o'clock [on the evening of July 17] one mystery was solved when an old razorbill came down from the top of the gully some two hundred feet up, accompanied by a big chick which made a perfect flight down, its diminutive wing stumps whirring as swiftly as a bee's, its little paddles spread wide in the appropriate manner. A 'scarl' of excitement from other razorbills lining the route extolled its triumph."

This young razorbill was accompanied by one of its parents. But what of a youngster who makes this first flight unattended ? The tragedy which then follows is vividly portrayed on pp. 143–144 :

"At a quarter past nine [at night] a chick suddenly appeared from nowhere in the water at the bottom of the gully and swam directly out to the open sea, crying its continual 'psee-ee-ee, psee-ee-ee', with wide-open bill. For some minutes it plied around outside the entrance to the gully, often looking up at the cliffs ; but no parent came to meet it. Its fate was inevitable, for it was still quite light, with a fine sunset reddening the North Cape. I waited sadly. Down came the accursed gull, as deadly quick as ever. And though the little fellow dived, and though three guillemots, waiting on their own chicks flighting down, made an onslaught on the gull, the latter hooked him by one shank and carried him dangling to a nearby reef. Then the monster beat and tore the life out of him savagely, though he struggled valiantly and with astonishing tenacity."

That the author can write well and vividly may be realized from his description of kittiwakes (p. 92):

"It is during the intervals of comparative quiet that a marvellous thing happens, when, suddenly, hundreds of kittiwakes zoom down from the ledges at a single impulse, shoaling out of the gully in a dazzling white and grey pack that has an hypnotic effect on the eye. Like snowflakes in a blue heaven, they wheel mazily over the whirlpools of white surf and the deep green Atlantic swell. By what miracle of flight-control do they avoid collision ? One will sometimes drop its brown webs and buffet another with its furled wings. And then with one accord the hundreds wheel around and soar up to their ledges in the gully. Their tumultuous clangour when they alight is almost overwhelming."

Take, again, his description (p. 59) of the first landing of the puffins on Lundy in March :

"While I sat for hours half hidden, an unbroken column of red-billed, red-webbed puffins hurtled with menacing directness at my boulder, swaying from side to side on the gale : like streams of tracer bullets radiating to their respective boulders seventy yards up and down the Slope. Sheering off easily, without shock, from my head, with a soft flutter-thud of keeling wings, the short black leaf-points of their spread tails projected fanwise on either side of their scarlet or orange shanks, as they turned to plane down to the sea with great *élan*.

"Hovering delicately, with flickering wings and hanging rose paddles, some pitch neatly on to their boulders, bowed forward into the wind, like turnstones, with great bills uptilted and convex wings lifted for some seconds well above the level of their backs in the manner of an alighting beetle, before standing fair and square on their vermilion shanks, so brilliant against the dull green and yellow lichen of the grey rock. But they soon take off again, drooping at head and stern, with perfect swallow-dives, and quiver like black hawk moths down the Slope : red webs, clasped together, stretched out behind, delicately fluttering wings arched a little convexly—a most graceful, fragile motion. They circle swiftly out over the sea, often mounting to four or five hundred feet with quick-beating whirring wings, and rejoin the throng of their fellows flighting like a scattered swarm of starlings hawking winged-ants."

There is a fine description, too, of the departure of the young guillemots from their ledges (p. 178 *et seq.*).

When the author can write so well, it is something of a shock to come across his lapses of style. For example, on p. 95 an account of the doings of kittiwakes brings the dreadful opening of a sentence, "As per usual", which shatters the flow of vivid narrative. The author, too, is fond of long and strange words : "exteroceptively" (p. 212) ; "territoried" (p. 184) ; "pre-incubationary" (p. 121) are examples. What is a "black-sitting" egg (p. 125) ? Nor is his habit of naming the greater black-backed gull the "great gull" or the "big gull" one to be commended.

It is of considerable interest to realize that the Lundy shags build their nests and lay so late in the season. Mr. Perry found that the first nest-building in 1939 took place on April 28, and the first egg (by the way, he is wrong in describing the shag's egg as "glossy") was not laid until May 24 (p. 218). In the north of Skye, a full 400 miles north of Lundy, I expect to find shags brooding their eggs by the first week in April, and have seen nesting material brought as early as February.

In his chapter, "Home from the Sea", the author advances an interesting theory to account for the periodic return, from mid-winter onward, of sea birds to their nesting rock. That ocean bird, the fulmar, I myself have seen at its breeding rock in early January, when the ground was hard frozen, and icicles hung from the cliff edges.

It is refreshing that the War should have failed to stop the publication of this book, which must be a source of interest, and of pleasure, to all bird lovers.

SETON GORDON.

SCIENCE, NATIONAL AND INTERNATIONAL, AND THE BASIS OF CO-OPERATION*

By PROF. A. V. HILL, O.B.E., F.R.S., M.P.

ONE of the great tasks lying before scientific people after the present War will be to rebuild, and to rebuild on a firmer and better foundation, the international scientific organizations which have come into being in the last seventy years, particularly during the present century. The earliest of these was the International Bureau of Weights and Measures, established in 1873. An International Geodetic Association followed, and in 1903 an International Seismological Association on the same lines. Arising from the initiative in 1898 of the Academies of Munich and Vienna, together with the Royal Societies of Göttingen and Leipzig, which had all been in the habit of meeting annually, the Royal Society of London undertook to approach a number of foreign academies with a view to the formation of an international association of academies. As an independent institution, not subject to State control as were so many of the academies, the Royal Society was in a very favourable position for opening such negotiations. As a result the International Association of Academies was formed, which held five meetings in all, the sixth at St. Petersburg being cancelled owing to the outbreak of war in 1914. It never met again.

These meetings were not limited to natural science, many of the academies being concerned both with the scientific and the humanistic side of learning. It is interesting to interpolate that as one result of this movement, and in order to represent Great Britain on the literary, philosophical and historical sides, the British Academy was formed and incorporated by Royal Charter in 1902.

Just before the end of the last war, in 1918, representatives of the academies of all the allied countries met in London, and later in Paris, to discuss the formation of a new international scientific organization. In July 1919, the first General Assembly of the International Research Council, as it was to be called, met in Brussels. Representatives of the Central Powers were not invited, and a misunderstanding which then arose was made an excuse for declining an invitation which was sent to each of them a few years later. This unfortunate state of affairs persisted. German professors who feel themselves insulted are difficult people to appease, and indeed the fault was not all on their side. International Unions for Astronomy, Geodesy and Geophysics, Chemistry and Mathematics (this last no longer in existence) were formed; and at the next General Assembly in 1922, for Physics, Scientific Radio, Geography and Biology. Some of these Unions have functioned well and have held important international congresses and done important work; others have done little. The ones that have worked best, for example, Scientific Radio, are those which had a more practical international task to fulfil.

These Unions always had an official or semi-official flavour: official delegates, official hospitality, official finance, official business, have tended to put independent science into a somewhat subordinate position. Physiologists have held international congresses for fifty years, and great value these have had, as we who have taken part in them know: but physiologists have always insisted that they came as independent men of science, to meet, to hear and to discuss things with their colleagues; not as representatives of some State institution or interest. Other scientific groups have held similar informal congresses based on the same idea. There is grave danger, as was found by the Physiological Congress meeting in Italy in 1932, and in the Soviet Union in 1935, of a congress being used as an opportunity for political propaganda; in 1938 this was altogether avoided by the tact and understanding of Swiss colleagues, as it had been avoided at meetings prior to 1932. Political considerations are hard enough to avoid anyhow, but they are much worse if a congress is not genuinely independent.

In Great Britain and in the United States, the strength and the high position of the independent scientific societies make it easy for them to take charge of the proceedings of a congress, or of an inquiry of international importance, without danger of State control—either in appearance or reality. But this is not so easy—indeed it has been impossible in recent years—in many countries. In order to preserve the integrity of science in our own country, it is very important that those strong independent scientific bodies should be maintained; and for the sake of international scientific relations it is desirable that in other countries also, so far as we can influence them, the domination of the State over science should be tempered by public appreciation of the part played by independent scientific agencies and institutions.

In some form or other, not one may hope

* From an address given at the annual general meeting of the Parliamentary and Scientific Committee on January 28.

exactly in their present form, these international unions must be started up again some day. This time, at any rate, we shall not be prevented from following our better judgment by the intransigence of French colleagues; though it may be hard enough for us this time to take a detached view. My own feeling is that in this matter we should rely, so far as possible, upon the help and advice of our American scientific friends. Their views about science, for its own sake and in relation to the State, are much the same as ours, and they (at present at least) are further from the battle. I know they would regard it as a sacred trust of friendship to bear a large part of the burden of starting off again the international co-operation in scientific endeavour which was so unhappily ended by the events of the last years. There is a high idealism in the United States about international co-operation in the field of science and learning, and a very great regard for British science and British scientific men. If the War goes ultimately as we expect, in the downfall of dictatorship and tyranny, it will be our job to start off again, on broader and better lines, the complex system of international scientific co-operation; and in starting it off I am sure that we shall be able to call for the help and co-operation, without stint or limit, of our scientific friends in the United States.

I have spoken several times of the necessity of guarding the independence, the spiritual integrity of science. In many countries to-day science is wholly subservient to the State; its soul is not its own. I do not deny for a moment the importance, indeed the necessity, of scientific organizations within the framework of Government, or of liberal support by the State of scientific research. One can only welcome such recognition by the public of the importance of scientific knowledge and scientific discovery—and ask for more. There are several things, however, which one may fear. First, the condition of stagnation and complacency which tends to develop in any scientific department or establishment which is cut off from outside criticism or ideas; we have far too many examples of this already, and if we are not careful they will multiply. Secondly, the danger that science will be planned by administrators in offices instead of by young men with their sleeves rolled up in laboratories or workshops. Thirdly, the disadvantage of separating teaching from research, to the great loss of the next generation, who may miss the inspiration of seeing discovery going on in the places where they are taught. Fourthly, a decrease in the influence and prestige of those independent scientific bodies which play so large a part in the social and intellectual activities of the scientific community and provide the cross-connexions between groups which might otherwise be isolated. Fifthly, the danger that he who pays the piper may call the tune, and that research may be required to be devoted primarily to objects which the politician, or the Civil Servant, regard for the moment as of national importance; or even—as in Germany and the Soviet Union—to bolstering up theories which the official philosophy of the State prescribes.

To avoid all these troubles, the independence and integrity of science must be carefully preserved; in the universities, in the learned societies, in the various associations or institutions devoted to the advancement of knowledge. Whenever State support is given, a buffer should be interposed, similar to that provided by the University Grants Committee between the universities of Great Britain and the Treasury. In our existing Research Councils (Department of Scientific and Industrial Research, Medical Research Council, and Agricultural Research Council), working with Government funds, the buffer is already provided by the fact that the members of the Councils are chiefly independent scientific men. The same safeguard exists at present with much of our State-aided research; we must carefully watch that the strength of this safeguard is fully maintained, that it does not become a formality, and that the principle is consciously extended wherever possible, as the financial burden of scientific research and development is taken over (as is bound to happen more and more) by the State.

In many of the departments of Government, however, notably those of the defence services, scientific research is undertaken, on a grand scale, which cannot be controlled directly by outside independent bodies. In these establishments particularly, the danger of stagnation and complacency exists. They are devoted to specific service purposes, often of necessity secret; and the condition of secrecy prevents them, in ordinary times, from attracting many of the ablest and brightest minds, who prefer the freer atmosphere of the universities, the possibility of discussing and publishing their results, and the recognition of their colleagues resulting therefrom. Consequently, in war, those who direct these establishments are often men who have arrived at their positions by seniority and long service, during which they have been largely isolated from the ideas and criticism of current scientific thought; it has been difficult for them not to become officials rather than working men of science. When an emergency occurs, as at present, numbers of able men come in, but to posts in which they can exert relatively little influence, and their ability and imagination may for long be imperfectly used. This indeed is inevitable under the present system, for they have at first no experience of service conditions and

needs. After a year or two perhaps—longer than necessary—these able people find their proper level, but not until much damage has been done by lack of imagination and energy in the posts they might have filled before.

To avoid this trouble—and it is a very real one—two main principles may be applied. First, to introduce into each department or organization some kind of scientific advisory council, similar to that which on the whole works so well now in the Ministry of Supply. This council should consist partly of independent scientific men chosen for their special knowledge on one hand, for their wide contact with the scientific community on the other; and partly of official scientific people representing not only the department or organization itself, but also a variety of other departments, so that a good cross-section of official knowledge and experience is available. Secondly, in ordinary times to arrange for regular interchange of personnel between the Government research establishments and organizations, and the universities and other independent institutions in which research is carried on.

I know that this second proposal will shock some of those who have lived in the traditional secrecy of service science; but it is right all the same. Why should not a chemist or mathematician from Woolwich, a physicist from the Signal School, an engineer from the Royal Aircraft Establishment, go back as a lecturer or professor to a university, or to the research staff in a commercial laboratory; just as a physiologist from the National Institute for Medical Research, or an aeronautical engineer at the National Physical Laboratory, or a zoologist at the Marine Biological Laboratory at Plymouth, may do? And why should not the research workers in Government laboratories be just as regular attendants at the meetings of scientific societies as those in other institutions?

The first need is for a common pension scheme. All scientific workers, whether in the universities, or in commercial laboratories, or in Government employment, should come under the Federated Superannuation System for Universities, as do those employed by the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Council. Then the Departments should insist on sending their people away at intervals, to carry on research elsewhere and to refresh their souls in institutions outside. Conversely, they should invite outside scientific workers (naturally under proper safeguards of secrecy when necessary) to work for corresponding periods in their establishments. The advantage of this second step would be that the importance and interest of the problems which are being tackled in Government establishments would be more commonly realized, and better men would be inclined to take part in their solution. In the defence services a reserve of officers and other ranks is an essential part of an efficient organization for war; in the scientific services similarly, a reserve of research workers, for the case of emergency of any kind, would seem to be equally essential.

One great advantage of working in the scientific establishments either of the Government or of a large company or corporation, is the fact that equipment is not limited below the minimum that is necessary for efficiency. As regards research in the universities of Great Britain, I should feel inclined, if a Government fund of say one million pounds were available for scientific research, to ask the University Grants Committee to allocate it to different universities. Each university would then deal with the disposal of the sum allotted to it, in much the same way as the Royal Society does with the Government Grant for Scientific Investigation; and as in the last few years the University of London has already done with a substantial fund which it has put aside for this very purpose from its own resources. I know from long experience, both personally and by helping to administer the Royal Society grant, the great advantage to the individual and to the institution where he works, of the possibility of obtaining a grant, possibly large, more often small, for a specific research project; to be expended by the young research worker (or the older one) at his discretion and not merely by the department. What the University of London has made a start in doing in this way, can be done by other bodies; but money will be required. In the days of straitened circumstances which we cannot but foresee ahead, it must come from the State if scientific investigation is to be kept up—as it must be; and the natural body to allocate it to its different claimants among the universities would be the University Grants Committee.

For research in industry, in medicine and in agriculture (apart from their overlap with university institutions) the machinery for similar grants exists already in the three Research Councils; with extended financial provision from the Treasury if necessary. In industry, at least part of the sum required should be subscribed by the industry itself, as it is at present, with the research associations devoted to various subjects and working in co-operation with the Department of Scientific and Industrial Research. The personal grants given at present by the latter Department for researches "of particular timeliness and promise" are of great value and could with advantage be extended.

THE FAUNA OF NEW ZEALAND

By H. BARRACLOUGH FELL

NEW ZEALAND has provided biological science with the classical and most striking case of the effects upon a fauna of prolonged isolation. For an immense period of time it has remained a sanctuary for archaic types. The facts about the kiwis, ground-parrots, wekas and other flightless birds are quoted in perhaps every zoological course in the universities of the world. Yet, these very animals so important to science are now in the gravest danger of becoming extinct[1] like the giant eagles and moas before them. The aid of zoologists in Britain and elsewhere is urgently needed to support the efforts being made by New Zealand workers to bring about reforms to save these animals, which, once lost, will never be known again. It is insufficient to have passed laws purporting to 'protect' them, when inadequate wild-life administration is available to enforce the laws. Active measures must be taken as soon as possible to destroy the complex of introduced pests which have ousted, or actually attacked, the defenceless native species. The problem is of the utmost importance, and we owe it to future generations, and especially to future biologists, not only in New Zealand but also throughout the rest of the world, to solve it now.

Last year New Zealand celebrated the first centenary of organized settlement. The time is opportune, therefore, for a general survey by qualified workers to ascertain the present position of the native animals and plants after one hundred years of contact with European forms. Such a survey would be in the interests of biologists everywhere, and its commencement should be urged by overseas societies. There is in existence already, in the Forest and Bird Protection Society of New Zealand, an organization capable and willing to undertake the work if sufficient support were forthcoming. The survey, if undertaken, would aim not only at establishing clearly the detrimental factors which have operated upon native forms during the period of settlement, but would also be concerned with finding effective remedies for the ills which are now besetting this unique fauna and flora, and with urging the adoption of the remedial measures by the Government. Despite the efforts of New Zealand biologists (notably the late Dr. Leonard Cockayne, the late Mr. H. Guthrie-Smith, and the Forest and Bird Protection Society), apathy has prevailed so long that it seems that only pressure from overseas can bring the country as a whole to realize the gravity of the position. Collaboration between New Zealand biologists and others (especially those working throughout the British Commonwealth) to decide a policy to be pursued, with concrete suggestions for a method of approach based on the facts ascertained from a wide and thorough survey, will do more to convince the New Zealand Government of the urgency of the matter than anything else.

The present position was expressed by Dr. C. G. Morice and Mr. B. C. Aston in April of last year, when they wrote: "Much has been said, but nothing done so far, in setting on foot a scheme to bring about improvement in the administration of wild-life matters. Opposition has, on the other hand, come from those bodies who receive revenue from licenses for the killing of fish and game. Thus we have the same old story, that an attempt is being made to sacrifice the interests of the majority of sportsmen on the altar of personal interest. In the meantime this Society continues to receive a large number of reports indicating ruthless poaching, illegal collecting, and other breaches of the existing Act, and, we fear, must expect to continue to receive such, in the absence of an adequate warden service. The waste of funds expended on guesswork decisions continues as in the past, and points more than ever to the need for adequate research by trained observers in the field."[2]

The value of national parks has been urged constantly by the Society,[2] and gradually such parks are being set up. The famous Tongariro National Park, in the North Island, took its origin in a gift to the nation from the Maori chief Te Heuheu. It has since been increased in area by the efforts of the Royal Society of New Zealand. As the introduced vermin, however, are still at large, much of the value of these areas remains incapable of realization. For example, in the Mount Cook National Park the flora is still being ravaged by the chamois and thar introduced for tourist publicity purposes, while the effect of weasels on the fauna of the same area has been described by A. P. Harper[4]. The back-country mountain ranges have, to some extent, acted as conservation areas by virtue of their difficult access. It has been proposed to celebrate the centenary by opening up a scenic highway in the Tararua Ranges, near Wellington. Realizing the danger

to the native fauna and flora from fire and interference, the Forest and Bird Protection Society has made an effort to oppose the plan[3], which as yet, apparently, has not been put into operation. Kapiti Island is an example of successful conservation on a small scale, but unfortunately is exceptional.

Some actual facts may be quoted to illustrate the tragic spoliation which is at present taking place. In 1925 the Forest and Bird Protection Society urged upon the Government the need for reservation of the Auckland Islands on account of their remarkable sub-antarctic bird fauna, particularly the nesting grounds of the albatross. The Government of the day refused on the grounds that the annual rental of the islands as a sheep station (£40) was of greater value than the avifauna. In 1934, after the sheep project had proved a costly failure, the Government officially reserved the islands. The sheep, however, are still there, and the destruction goes on[6,7].

It has been estimated that there are a million cats in New Zealand, many of them having gone wild; probably some ten million birds are destroyed every year by these animals alone[8,9]. A cat belonging to a lighthouse keeper has destroyed an entire species (the endemic Stephen's Island flightless wren)[10]. Weasels and stoats rob the nests of the flightless wekas—birds which serve as protectors of other native species owing to their destruction of rats[11]. As the weka declines in numbers, so the rats are increasing, and the native birds grow fewer and fewer. Every year many kiwis and wekas fall victims to the traps of the opossum-hunters[1,12]. Wild pigs, dogs, and human interference have combined to make kiwis scarce in all but the remotest areas.

The evils of badly conducted acclimatization are notorious in the case of the rabbit. Not so well known overseas are some of the other examples which are having an equally disastrous effect upon the native fauna. The unfortunate introduction of the German owl by the Otago Acclimatization Society has burdened the country with a voracious pest which does not hesitate to attack and kill fantails, warblers, tomtits and other small native birds[13,14]. The native owl, or morepork, awaits darkness before beginning to hunt, and thus does not attack native birds. The introduced Australian black swan supplants the less vigorous native duck and teal by taking their food. Shooting by sportsmen has also reduced their numbers, and in this particular matter the present Minister of Internal Affairs has repeatedly warned the acclimatization societies of the need for conservation[15]. The draining of the swamps deprives the pukeko of its natural haunts, and drives it into the open, where it is shot by thoughtless sportsmen. The warnings of naturalists on this matter[4] have gone unheeded.

Man himself has committed great evils against the native fauna, and still is doing so. Reischek and his fellow commercial collectors of the last century filled the museums of Europe with the dried or stuffed skins of New Zealand's rarest birds. Their native country, alas, knows the living species no more. Thus was lost the huia (*Heterolocha acutirostris*), a bird unique in having radically different skull-forms in the two sexes. Mistakes such as these will not be repeated. But in the matter of commoner species, destruction is still going on, and other species may yet be extinguished by man. Thus, every year all species of shags are shot by fishermen on the supposition that they eat trout. The Forest and Bird Protection Society has shown that only one species, the black shag, is responsible; but the shooting goes on[2]. Godwits are shot every year during migration when they gather at the North Cape before making their six thousand mile flight to Siberia[17].

In an attempt to replace the forests which had for too long been allowed to be depleted, thousands of acres of quick-growing *Pinus radiata* and other exotic conifers were planted. No native plants grow on the darkened, needle-covered floors of these artificial forests; there is no native bird-life where there are no natural berries for them to eat[18,19]. The Nothofagus forests on many of the ranges are now dying or already dead owing to the introduced deer stripping the bark from the trees with their antlers, and destroying the absorbent mosses of the sub-alpine forest floor[20,21]. In the train of this destruction has come erosion, and in this matter the Government has been forced to act[22,23].

[1] *Forest and Bird*, **45** (1937).
[2] Annual Report, Forest and Bird Prot. Soc. (1939).
[3] *Forest and Bird*, **53** (1939).
[4] Harper, A. P., *Forest and Bird*, **40** (1936).
[5] *Forest and Bird*, **45** (1937).
[6] *Forest and Bird*, **44** (1937).
[7] Guthrie-Smith, H., "Sorrows and Joys of a New Zealand Naturalist" (1936).
[8] Pearson, T. G., *Forest and Bird*, **31** (1933).
[9] *Forest and Bird*, **43** (1937).
[10] Oliver, W. R. B., "New Zealand Birds", p. 441 (1930).
[11] Guthrie-Smith, H., "Tutira".
[12] *Forest and Bird*, **38** (1935).
[13] *Forest and Bird*, **37** (1935).
[14] McCaskill, L. W., *Forest and Bird*, **23** (1932).
[15] *Forest and Bird*, **51** (1939).
[16] *Forest and Bird*, **40** (1936).
[17] Kirk, Major J. R., *Forest and Bird*, **41** (1936).
[18] *Forest and Bird*, **45** (1937).
[19] Collins, G., *Forest and Bird*, **41** (1936).
[20] *Forest and Bird*, **48** (1938).
[21] *Forest and Bird*, **39** (1936).
[22] Bulletin No. 77, Department Scientific and Industrial Research, Wellington (1939).
[23] *Forest and Bird*, **54** (1939).

NOTE.—*Forest and Bird* is the quarterly journal issued by the Forest and Bird Protection Society, Wellington. The society is formed under the patronage of Viscount and Lady Galway and the Maori Bishop of Aotearoa.

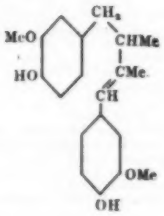
CONSTITUENTS OF NATURAL PHENOLIC RESINS

By PROF. R. D. HAWORTH,

UNIVERSITY OF SHEFFIELD

THE resinous secretions and deposits of plants are frequently resolvable into crystalline carboxylic acids, alcohols and phenols of terpenoid or *n*-propylbenzenoid (C_6–C_3) structures. Abietic acid and the amyrins are examples of terpenoid constituents, and cinnamic acid and coniferyl alcohol represent C_6–C_3 types. The widespread occurrence of the C_6–C_3 structure in plant pigments, essential oils, amino-acids, alkaloids, resins, etc., is of special interest in connexion with the natural phenolic resins, from which a group of compounds possessing the skeleton structure, C_6–C–C–C–C–C_6, has been isolated. These substances occur in many natural orders of plants, but their frequent association with the heartwoods and exuded resins of the Coniferæ is noteworthy. The term 'lignan' was introduced[1] to include all substances containing this carbon framework, derived from the combination of two C_6–C_3 units at the β-carbon atom of the C_3 chain. The lignans are catechol derivatives differing in the degree and kind of alkylation of the phenolic groups and in the state of oxidation of the non-aromatic portion of the molecule. The structural formulæ and natural sources of the lignans are included in the accompanying formulæ, where a convenient classification into three sub-groups, *a*, *b*, and *c*, is adopted.

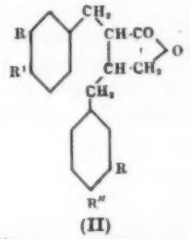
(a) DIARYLBUTANES



(I)

Lignans:
l-Guaiaretic acid
l-Dihydroguaiaretic acid (–CH–CH_3– for –C = CH–)

Occurrence: *Guaiacum officinale* (wood)

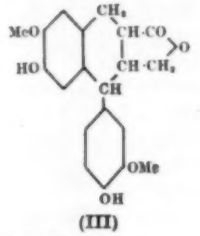


(II)

Lignans:
l-Matairesinol (R = OMe; R′ = R″ = OH)
l-Hinokinin (RR′ = RR″ = CH_2O_2)
l-Arctigenin (R = R″ = OMe; R′ = OH)
l-Cubebin (RR′ = RR″ = CH_2O_2; with CHOH instead of CO)

Occurrence:
Podocarpus spicatus (wood)
Cupressus obtusa (wood)
Arctium lappa (seeds)
Piper cubeba (seeds)

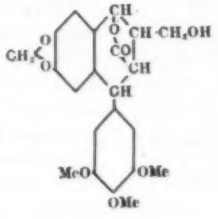
(b) TETRAHYDRONAPHTHALENES



(III)

Lignan: *l*-Conidendrin

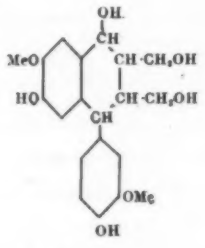
Occurrence:
Waste sulphite liquors
Tsuga Sieboldii (wood)
Picea excelsa (wood)
Podocarpus spicatus (wood)



(IV)

Lignan: *l*-Podophyllotoxin

Occurrence: *Podophyllum pellatum* (roots)



(V)

Lignan: *d-iso*Olivil

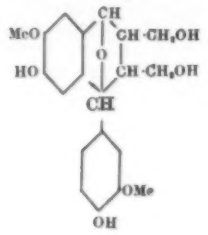
Occurrence: *Olea Cunninghamii* (wood)

The ethers of the three sub-groups, *a*, *b*, and *c*, are attacked by nitric acid in different ways; the diarylbutanes give dinitrolignans, the tetrahydronaphthalenes yield amorphous products of unknown constitution, and the tetrahydrofurans are degraded to 4 : 5-dinitroveratrole[3]. Reduction at the benzyl ether linkages is characteristic of the tetrahydrofurans, and the dimethyl ether of *d*-pinoresinol (VIII) may be reduced either partially to the dimethyl ether of *d*-lariciresinol (VII) or completely to the *l*-diol (IX; R = CH_2OH)[3]. The diarylbutanes and tetrahydronaphthalenes are also distinguishable by oxidation of the lignan ethers; the former are degraded to substituted benzoic acids, and the latter yield a substituted *o*-benzoylbenzoic acid and a dibasic acid of type (X; R = CO_2H)[4]. Furthermore, smooth dehydrogenation of tetrahydronaphthalenes can be effected with lead tetra-acetate[5], and the conversion of the methyl ether of *l*-conidendrin (III) into the lactone (XI) orientates the lactonic group of conidendrin and excludes an alternative based on structure (XII).

The dimethyl ethers of *l*-guaiaretic acid (I), *l*-olivil (VI), *d*-*iso*olivil (V) and *d*-lariciresinol (VII) are converted into the substituted naphthalenes (X; R = Me), and the dimethyl ether of *d*-pinoresinol (VIII) into the furan (XIII), on heating with selenium[6]. This reaction is not applicable to methylenedioxy lignans; but these may be related to the corresponding methoxy derivatives by demethylenation and subsequent methylation.

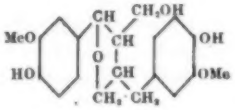
Derivatives of types (X), (XI), (XII), and (XIII) retain all the carbon atoms of the lignans, but lack the optical activity associated with the natural products. Methods for the synthesis of compounds of types (X; R = CO_2H or Me)[6,7] (XI)[8], (XII)[9,10], (XIII)[6] and (XIV; a degradation product of *d*-lariciresinol)[11] have been developed, and the inactive lignan derivatives have been identified by comparison with synthetic specimens. The establishment of the structures of these lignan derivatives provides a proof of the presence of the fundamental carbon framework, C_6–C–C–C–C–C_6, (C C) which applies rigidly to all products represented by formulæ I–VIII. A synthesis of the optically active modifications of type (II) has also been introduced and applied to the synthesis of *l*-matai-resinol and *l*-hinokinin[12]; but complete syntheses of other optically active types are

(c) TETRAHYDROFURANS



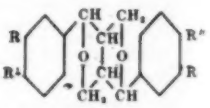
(VI)

Lignan: *l*-Olivil
Occurrence: *Olea europea* (resin)



(VII)

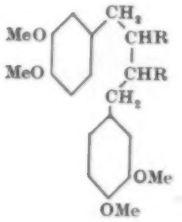
Lignan: *d*-Lariciresinol
Occurrence: *Lariz decidua* (resin)



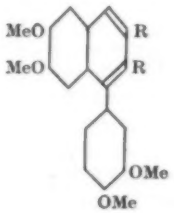
(VIII)

Lignans:
d-Pinoresinol (R = OMe; R′ = R″ = OH)
l-Eudesmin (*l*-pinoresinol) dimethyl ether (R = R′ = R″ = OMe)
d-Forsythigenol *epi**pinoresinol) monomethyl ether (R = R′ = OMe; R″ = OH)
d-Sesamin (RR′ = RR″ = CH_2O_2)
l-Sesamin
l-Asarinin *epi**sesamin)
Occurrence:
Pinus nigra, *Pinus silvestris* and *Picea abies* (resin)
Eucalyptus hemiphloia (kino)
Forsythia koreana (leaves)
Philyrea latifolia (bark)
Sesamum indicum (seeds)
Asarum Sieboldi
Asarum Sieboldi, *Asarum Blumei* Duch.

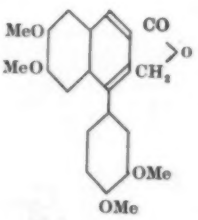
* *epi*Pinoresinol and pinoresinol differ in the stereochemical configuration at one or both of the *a*-carbon atoms.



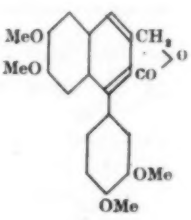
(IX)



(X)



(XI)



(XII)

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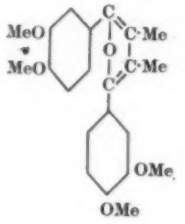
not available. Numerous partial syntheses have, however, been realized by interconversion of members of the lignan group, for example:

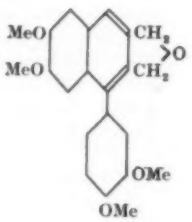
(13) (14) (15)
l-cubebin → *l*-hinokinin → *l*-matairesinol → *l*-conidendrin

(3) (16)
d-pinoresinol → *d*-lariciresinol

The lignans present an interesting stereochemical problem in which some advance has been made. Natural lignans of type (II) are synthesized from optically active anyhdrides of dibasic acids of type (IX; R = CO_2H)[12], and unless optical inversion occurs during the reaction, a *trans* configuration must be assigned to the product. The hydroxy-acid obtained from *l*-matairesinol is partly converted by hot alkali into a diastereoisomeric modification, and comparison[10] of the rates



(XIII)

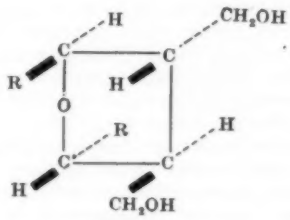


(XIV)

of lactonization of the two hydroxy-acids supports the *trans* configuration of *l*-matairesinol. The presence of asymmetric centres at one or both of the α-carbon atoms is an additional complication in the tetrahydronaphthalene and furan subgroups, but there is considerable evidence that the matairesinol configuration of the β-carbon atoms is retained throughout the lignan family. The conversion of the methyl ethers of *d*-pinoresinol and *d*-lariciresinol into the *l*- (and not *meso*-) form of the diol (IX; R = CH_2OH)[8] supports this view.

The proof that the phenolic groups are symmetrically disposed in *l*-olivil[17] and *d*-pinoresinol[18], together with the optical activity, shows that these molecules, whilst lacking planes, centres and alternating axes of symmetry, must possess a symmetry axis. Numerous configurations are eliminated by these requirements, and the remaining structures (two for each lignan) retain the matairesinol configuration at the β-carbon atoms. Little information is available concerning the configuration at α-carbon atoms. Cinnamic acid and coniferyl derivatives occur naturally in the stable *trans* form, and Vanzetti[19], postulating that lignans arise from the union of two coniferyl molecules, has proposed the *trans* structure (XV; R = guaiacyl) for *l*-olivil. A comparison of the properties of the four modifications of 1-phenyltetrahydronaphthalene - 2 : 3-dicarboxylic acid[20] suggests that the most stable acid possesses *trans* linkages in the 1 : 2- and 2 : 3-positions, and this conclusion inferred from a compound containing three asymmetric centres is consistent, so far as it goes, with the *l*-olivil structure (XV).

Although the synthesis of lignans from C_6–C_3 types has not been reported, the widespread occurrence of the unit and the formal analogy of the coniferyl-lignan to the terpene-diterpene relationship indicate the importance of the C_6–C_3 unit in the construction of natural products. Tri-coniferyls, corresponding to the triterpenes, are unknown; but the few established structural features of lignin chemistry are consistent with the view that lignin represents the polyterpene of the C_6–C_3 metabolism. The absence (or small



(XV)

proportion) of phenolic groups in lignin suggests, however, an important difference in the mechanisms of the hypothetical polymerizations of the C_6–C_3 type to lignans and lignin respectively.

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OBITUARIES

Prof. Miles Walker, F.R.S.

DR. MILES WALKER, emeritus professor of electrical engineering in the University of Manchester, whose virile personality, sometimes tempestuous, always lovable, endeared him to all, passed peacefully away on January 22, at the age of seventy-three. Prof. Walker had by no means relinquished the strenuous life in favour of a country retirement, so well earned and so open to acceptance in the delightful home he had chosen amongst the Cotswolds at Amberley. The tale of Walker's career sounds strange unless one realizes the intense persistence which was so marked a characteristic in him.

Trained originally for the law, and in fact fully qualified and in practice in a solicitor's office in London, Walker found the lure of physics and engineering irresistible; this urge had been kindled and then thwarted when, as a boy, he browsed in his father's library in such books as Fownes "Chemistry", and visited his engineer uncle at Naworth Collieries, only afterwards to be articled to solicitors in Carlisle. Jumping the traces then in 1891, he registered as a student under Sylvanus Thompson and John Perry at Finsbury Technical College, London, being considerably older than his fellow students, and indeed continuing to pursue his law practice for a time.

To Walker the lectures proved fascinating, and he was delighted to find himself actually handling the tools, instruments, and machines he had read about. There was then no turning back for him. It is doubtful whether Walker had any preconceived career in mind when, in 1896, after acting as personal research and literary assistant to Sylvanus Thompson for three years, he proceeded to Cambridge to read for the Natural Sciences Tripos and afterwards the Mechanical Science Tripos, gaining a first in each (1898–99). It happened just then that the British Westinghouse Co. was inquiring from Prof. J. A. Ewing for engineering students whom it could send for a while to the works of the Westinghouse Electric and Manufacturing Co. at East Pittsburgh in the United States, to form upon their return a technical nucleus at the newly established Trafford Park Works. Walker joined that party of some forty and proved to be an outstanding member.

Walker's work at Trafford Park, as designer of alternating current machinery during the period 1903–12, refused to be trammelled by accepted traditions of design, and such innovations as the multiple radial commutator for high-speed D.C. generators, the locally saturated cylindrical rotor of self-regulating turbo-alternators, and novel features in rotary convertors and phase advancers came forth prolifically. But how could Walker but kick against the traces in a commercial organization with its necessary restrictions! Keen as he ever was for the practical, he found his real niche upon accepting in 1912 the chair of electrical engineering at the School of Technology, Manchester, that is, under the Faculty of Technology of the Victoria University, but retaining touch with practice by acting as consultant to his old firm—afterwards named Metropolitan-Vickers Electrical Co. Ltd.

Many examples could be given of Walker's persistence and nursing of a problem for years; for example, the identity of mathematical relationship subsisting between fundamental quantities in gravitational and electromagnetic problems had often caused him to question whether there might not be a gravitational effect corresponding to mutual induction. He had pondered on this at least as early as 1899, and the advice of authorities in Cambridge at that time had not definitely discouraged experimental work, but his first opportunity to investigate occurred after taking up professorial work in 1912, when he started a research student upon the problem. Using a 480-lb. vertical spindle flywheel as inducing mass, close to but elaborately shielded from a 23-lb. porcelain disk as receiver carried by a bifilar suspension from the top of the building, Walker was able to determine (Walker and Stainer, *Phil. Mag.*, **32**, 592–600) that if any such mutual inductive effect existed, the ratio of change of moment of momentum induced to that inducing it, must be less than 5×10^{-10}, a result reached only after a succession of precautionary measures.

It was typical of Walker that, pleased as he was with the final determination of this minute upper limit, his concern for his research student became pronounced lest the negative nature of the result should detract in fact from the assessed value of the investigation in the matter of academic award to the student.

During the War period, 1914–18, Walker was an active member of the Lancashire Anti-Submarine Committee, but he also devoted much attention to other war problems of his own devising. In 1924, when Sir Ernest Rutherford at the Cavendish Laboratory needed to produce very large momentary magnetizing forces, he turned naturally to his friend Walker, asking him to advise Dr. Kapitza. Walker was able to make valuable suggestions in the matter and to arrange for the work to be suitably placed. This plant later formed part of the equipment of the Mond Laboratory at Cambridge.

Throughout his life, Walker was an idealist impelled by very strong convictions and conclusions, arrived at, he believed, with unanswerable logic. He was in consequence sometimes difficult in debate although always transparently honest and sincere. These ideas were often unconventional and ranged over the whole spectrum of human welfare; thus his address as president in 1932 of Section G to the British Association started on an engineering basis but was soon frankly given over to a humanistic review, and even so had been much expurgated by Walker, regretfully, but upon previous official advice. Walker was an ardent supporter of the M.K.S. system of

units, of rationalized spelling of English, and of universally available cheap electric supply.

Walker married in 1903 Miss Eveline Sargent, and they later adopted two boys in whose education and up-bringing they jointly found much pleasure. The boys are now serving in the fighting forces. Walker married in 1935 Miss Valeria D. Ellis, who survives him.

Walker was an untiring author, having served a notable apprenticeship during his association with Sylvanus Thompson. His best-known books are: "The Specification and Design of Dynamo-electric Machinery", "The Diagnosis of Troubles in Dynamo-electric Machinery", "The Control of Speed and Power Factor of Induction Motors", "Conjugate Functions for Engineers". He served as special lecturer at the Imperial College of Science and Technology in 1911, and at the Massachusetts Institute of Technology in 1921. A. B. FIELD.

Sir John McFadyean

WE record with regret the death of Sir John McFadyean, formerly principal of the Royal Veterinary College, who died on February 1 at the age of eighty-seven.

John McFadyean was born on June 17, 1853, the second son of Andrew McFadyean of Barrachan, Wigtownshire. He received his early education at the Ewart Institute and later proceeded to the Royal (Dick) Veterinary College, Edinburgh, from which he was admitted to membership of the Royal College of Veterinary Surgeons in 1876. On obtaining his diploma he was appointed lecturer in anatomy at the College and while so engaged attended classes at the University of Edinburgh as a medical student, graduated bachelor of medicine and master of surgery in 1882 and bachelor of science in the following year. In addition to his teaching in anatomy, McFadyean turned his mind to pathology and bacteriology, subjects then in their infancy. In 1892 the curriculum of veterinary education was extended from three to four years, and far-reaching changes were made in the general standard of education. McFadyean, who had already made a name for himself by his work on tuberculosis, was appointed professor of pathology at the Royal Veterinary College, London, and two years later became principal, which office he held until 1927.

There are few diseases of the domesticated animals to which he has not contributed valuable information, and numerous select committees and Royal Commissions have been largely guided and assisted by his knowledge and experience. He was a tireless worker, and for many years his private researches were carried out during the night hours. In 1888 he founded the *Journal of Comparative Pathology and Therapeutics*, in which much of his work is recorded.

McFadyean was a great principal and a great man of science; but he will be best remembered by a grateful profession as an equally great teacher, for he possessed eht rare gift of imparting his knowledge to his students in a manner which was readily understandable. By his work he showed nearly half a century ago that there were new and wider fields of veterinary science to be explored. His researches into diseases affecting animals in tropical and sub-tropical countries as well as in Great Britain and in Europe, created what has now come to be known as preventive veterinary medicine and by his teaching he provided the pioneer workers in this new field. We owe it to his sound knowledge and foresight that the veterinary profession was prepared to move in this direction far in advance of official demands.

In 1893 McFadyean was elected a member of Council of the Royal College of Veterinary Surgeons, and was president of that body from 1906 until 1909 and again during 1930–31 on the occasion of the meeting of the International Veterinary Congress in London, "McFadyean's Congress" as it was called by the eminent foreign delegates who attended from all parts of the world. During the forty-seven years that he served on the Council, McFadyean's personality dominated its deliberations, as it did the field of veterinary science, and the profession owes much of its solid progress through that difficult period to his wide knowledge of men and matters. On his retirement from the principalship of the Royal Veterinary College in 1927 he was elected an honorary associate of the Royal College of Veterinary Surgeons, the highest honour that that body could bestow, and in 1933 he received the first award of the diploma of fellowship *honoris causa*. After his retirement Sir John pursued his studies with unabated enthusiasm, absorbed almost until the end in his great life-work for veterinary science.

In 1883 he married Mara Eleanor, eldest daughter of Thomas Walley, principal of the Royal (Dick) Veterinary College, Edinburgh. She died in 1929. He leaves three sons and two daughters, to whom we offer our sympathy in their bereavement.

J. B. BUXTON.

Mr. C. Thurstan Holland

ON November 5, 1897, less than a year after the discovery of X-rays, a paper on the subject was read by Sylvanus Thompson at a meeting which was held to inaugurate the formation of the Roentgen Society. Among those present at this meeting were a few medical men who decided to devote themselves to the application of the new discovery to the needs of medicine. Of this very small band Thurstan Holland was one, and within a few years he had become the most eminent exponent of this new branch of medicine in Great Britain. He was elected president of the Roentgen Society in 1904 and again in 1916. In his address on the latter occasion he wrote: "It is twenty years since I took my first radiograph, twenty years brimful of interest, and of advances which in those days none of us could have even dreamed about, advances which may perhaps be illustrated by the fact that the first successful radiograph I saw taken [by Oliver Lodge in January 1896] was that of a hand, and the exposure was

1½ hours". He lived to see such exposures made as a routine in 1/10 second, even with apparatus that was mobile and could be readily taken round the wards to the patients.

In the rapid evolution of medical radiology and its applications to almost every branch of medicine and surgery, particularly in urinary radiology, Thurstan Holland took a leading part. He was one of the first to demonstrate the presence of a stone in the kidney and to obtain the shadow of the kidney outline as a *sine qua non* of a satisfactory radiograph of the kidney region. His meticulously careful technique and expert knowledge of photography resulted in the production of radiographs that were far in advance of standard practice for many years. Moreover, he brought to the task of the interpretation of his results exceptional clinical experience that was coupled with logical and rapid judgment. Little wonder, therefore, that he made his mark not only as a pioneer but also as a leader.

Although he practised in Liverpool, he nevertheless found time to keep in close touch with his colleagues in London, where he served on almost every radiological committee of importance. His commanding presence and outstanding personality were asociated with an exceptional rapidity of judgment and a knack of getting down to essentials. His influence on committees was profound.

Thurstan Holland's contributions to the literature of medical radiology were numerous and covered a wide field. So early as 1898–99 he wrote on the successful treatment of lupus and eczema by means of X-rays. Later he turned his attention to the diagnosis of chest conditions and those of the urinary tract. Working with his friend the late Sir Robert Jones, he made many valuable contributions to the study of diseases and abnormalities of bones. The Royal College of Surgeons acknowledged the value of this work by electing him as a fellow of the College. A list of about a hundred of his papers up to 1922 lies before me, covering practically every field of medical radiology that had been explored up to that time.

During the War of 1914–18 Holland served as a Major in the First Western General Hospital. His common-sense methods in the localization of foreign bodies were adopted by many radiologists.

He attained to all the honours that were possible in his branch of medicine and was president of the Electro-therapeutic Section of the Royal Society of Medicine, of the Roentgen Society (twice), of the British Institute of Radiology, and, highest honour of all, was elected president of the First International Congress of Radiology in 1925.

Outside his profession his hobbies were alpine photography and mountaineering. During the last fifteen years of his life he lived in retirement; but he still took an active interest in radiology and, as *doyen* of the radiologists, he attended many of the public functions until ill-health supervened. With his passing on January 16 at the age of seventy-seven, radiology has lost a leader, the last of the pioneers, who did much to establish this branch of medicine on a sound basis. A. E. BARCLAY.

Prof. T. R. Wilkins

NEWS has been received of the sudden death on December 10 of Prof. Thomas Russell Wilkins, professor of physics in the University of Rochester, New York. He was in his forty-ninth year.

Born in Toronto, Canada, he graduated at MacMaster University and came to Great Britain for post-graduate work at Cambridge. Before going to Rochester he held teaching posts at the University of Chicago, and at Brandon, Canada.

When the Institute of Applied Optics was founded at Rochester in 1928, Wilkins was placed in charge, and the success of the Institute owed a great deal to his interest and enthusiasm. His main scientific interests were always, however, in the realm of atomic physics, and he recently relinquished the optics post in favour of Prof. Brian O'Brien.

Wilkins was an enthusiastic research worker and his main line consisted in the study of cosmic ray and radioactive processes with the aid of photographic emulsions, a technique to which he made notable contributions, but not without long and laborious hours at the microscope.

Prof. K. F. Wenckebach

PROF. K. F. WENCKEBACH, an eminent Viennese physician and a founder of modern cardiology, whose death has recently been announced, was born at The Hague on March 24, 1864. After serving as an assistant at the Institute of Zoology and Pathology of Utrecht, he was appointed professor of internal medicine at Groningen in 1901, where he remained until 1911, when he was transferred to the corresponding chair at Strassburg. He held this post until 1914, when he was appointed professor of medicine at Vienna, retiring in 1929. He at first devoted his attention to embryology, but his subsequent work, for which he is best known, was concerned with the pathology and clinical aspects of cardiovascular disease and particularly cardiac arrhythmia. In 1920, in association with Prof. Jagic, he founded the *Wiener Archiv für innere Medizin*, of which his students offered him a *Festschrift* on the occasion of his retirement in 1929. During the occupation of his chair at Vienna he attracted a large number of practitioners and students interested in cardiology. He had many friends in Great Britain, where he was elected an honorary fellow of the Royal College of Physicians in 1928 and of the Royal Society of Medicine in 1930. J. D. ROLLESTON.

WE regret to announce the following deaths:

Sir Frederick Banting, K.B.E., F.R.S., professor of medical research in the University of Toronto, on February 21, aged forty-nine.

Prof. William J. A. Bliss, emeritus professor of physics in the Johns Hopkins University, on December 27, aged seventy-three.

Dr. J. G. Priestley, reader and demonstrator in clinical physiology in the University of Oxford, on February 9.

NEWS AND VIEWS

Charles Chree Medal and Prize

THE Charles Chree Medal and Prize, founded by Miss Jessie Chree in memory of her brother, the late Dr. Charles Chree, is to be awarded biennially to men of science who have contributed to the advancement of knowledge in those subjects in which Dr. Chree was particularly interested, and to which he had made signal contributions. The responsibility for, and the administration of, the award has been placed by Miss Chree in the hands of the Physical Society, and the Council of the Society has made the first award of the Medal and Prize to Prof. Sydney Chapman. Many minds in many countries have contributed to the advancement of the science of geomagnetism, and there are few branches of physics in which international co-operation is more desirable. British physicists have played a full part in the development of the science—Norman, Gilbert, Halley, Sabine (may we claim Lamont ?), and Chree himself, are outstanding names.

Prof. Chapman's contributions to the science are many and distinguished. His investigations of the diurnal variations and the separation of the solar and lunar effects have involved the handling of a mass of observations the magnitude of which has been well described as appalling. Prof. Chapman has analysed these observations with characteristic skill, devising new methods for the attack on this vast mass of data. Very important additions to our knowledge of the mechanism of the variations have resulted from Prof. Chapman's work. His analyses of the changes occurring in magnetic storms have resulted in a corpuscular theory of the origin of the storms. He has made weighty contributions to the critical literature of the subject and his latest volume, "Geomagnetism", written in collaboration with Prof. Bartels, is likely to remain for a long time the most detailed and authoritative treatment of the subject. The motto, *Sol rotatur magnetica respondet terra*, appears on the reverse of the Chree medal. This is a fitting comment on one aspect of the work of the recipient of the first Chree Medal.

Mrs. C. Neville-Rolfe, O.B.E.: Snow Medallist

As announced in NATURE of January 25, p. 114, Mrs. Neville-Rolfe has been awarded the Snow Medal by the American Social Hygiene Association. The medal is given annually for distinguished services to humanity. This was the first time the medal has been awarded outside the United States, and the only occasion on which it has been given to a woman. Mrs. Neville-Rolfe has been not without honour in her own country, but her qualities of courage and service have been, perhaps, more clearly seen by those interested in the promotion of social welfare in the great American republic. She is the eldest daughter of the late Admiral of the Fleet, Sir Cecil Burney, Bart.; her husband is Commander Clive Neville-Rolfe, who is at present on active service; while her brother is Commander Sir Dennistoun Burney, Bart, also on active and special service. Courage, therefore, comes naturally to her, and during the War of 1914–18 she saw where certain work was necessary, where no one else was doing it. It was not easy or popular work, and brought a good deal of prejudice to those who formed what is now known as the British Social Hygiene Council to fight one of the most serious and insidious forms of illness which, during and after the War of 1914–18, created considerable havoc both among individuals and homes in Great Britain.

Since that time, Mrs. Neville-Rolfe has been distinguished in pioneering effort, she has covered the whole country of Great Britain, lecturing, interviewing and organizing. She has taken her message overseas to Malta, Cyprus, India, Malaya, Hong Kong and the West Indies, and the Colonial Office has shown its appreciation of her work. She has visited and lectured in the United States, and is widely known as an eloquent and impressive speaker and as a pioneer in social welfare. It is good at this time to see that British and American people and organizations are appreciating each others qualities of service, and the bestowal of the Snow Medal on such an outstanding woman of Great Britain by the American Social Hygiene Association is a gratifying proof of this development.

Education in Social Hygiene

WHILE various professional organizations are interested in the vocational aspects of biology in education, and others are associated with certain special parts, it has been left to the Educational Advisory Board of the British Social Hygiene Council almost alone to concern itself with the value of biology as a medium of genuine education for people of all types and of all ages. Over the last three years, during which he has held the position of education officer to the Board, Mr. T. H. Hawkins has been working for a more generous appreciation of biology in the schools. His work has brought him into constant touch with educational authorities in all parts of the country, and much of his time has been taken up with conferences and discussions of problems of teaching technique. In recent months he has been active in the new movement for the service of youth, giving talks to adolescent boys on personal development and human biology. His position has been one calling for personal initiative, human insight, knowledge of public administration, and ability to get on with people of all shades of opinion.

Now, in relinquishing his post to take up an educational appointment in Trinidad under the Colonial Office, he is presented with a fresh field for his endeavours, in which problems of human biology

appear in a clearer light than they do at home, even if differing only in degree. His experience of biology in education in England should help to give a fresh interpretation to teaching practice in the Colonial Empire. Mr. Hawkins is to be succeeded by Mr. H. C. Bibby. Mr. Bibby entered Queens' College, Cambridge, in 1931 and became College Prizeman in 1933, graduating in 1935. He has examined the flora of the hot springs of Iceland, and was awarded the degree of M.Sc. of the University of Liverpool for ecological research. He is the author of research papers and nature study articles. He has been science master in Oulton School, Liverpool, and senior biology master in Chesterfield Grammar School. He has the advantage of considerable experience in organizing camps and in various other forms of youth work. His appointment to Mr. Hawkins's important though difficult post seems a very happy one.

Presidency of the Institution of Mechanical Engineers

MR. ASA BINNS, the retiring president of the Institution, was born in Keighley, Yorkshire, in 1873, and was educated at the Grammar School, Keighley, and at the University of Leeds. His workshop training was obtained at the works of Messrs. Tannett Walker and Company, Leeds, and Messrs. Cole, Marchent, and Morley, Ltd., Bradford. After a period as draughtsman in Ipswich with Messrs. Ransomes, Sims, and Jefferies, he joined the staff of the Hull docks of the then North Eastern Railway in 1898, thus beginning an association with dock work which has since been continuous. A few years were spent with the Admiralty Works Department, and in 1906 Mr. Binns was appointed to the London and India Docks Company, and remained with the Company's successor, the Port of London Authority, until his retirement from the post of chief engineer in 1938, when he was retained as consultant. He is now consultant to Messrs. Rendel, Palmer, and Tritton, consulting engineers. He has been a member of the Institution of Mechanical Engineers since 1902. He contributed a paper on "Recent Developments in the Mechanical Equipment of the Port of London Authority" (*Proc.*, **122**, 575; 1932) which was presented in May 1932 at the spring meeting of the Institution in London. Mr. Binns became a Whitworth exhibitioner in 1896.

Mr. W. A. Stanier has been elected to succeed Mr. Binns as president of the Institution of Mechanical Engineers. He has been a member of Council of the Institution for many years. He served his apprenticeship with the Great Western Railway at Swindon, and reached the position of principal assistant to the Chief Mechanical Engineer of that Company. His outstanding ability as a locomotive engineer was emphasized by a striking decision of Lord Stamp in appointing him chief mechanical engineer of the London, Midland and Scottish Railway, straight from his position as principal assistant at Swindon. It is particularly fitting that the chief locomotive engineers of Great Britain should follow their famous predecessor, George Stephenson, in the president's chair.

The Right Hon. Lord Harlech, G.C.M.G.

WHEN Lord Harlech takes up the office of High Commissioner in South Africa, to which his appointment was announced on February 21, he will enter upon his duties with a long experience of affairs and a judgment matured and affirmed by an intimate knowledge of the problems of British dependencies, and more especially of those of Africa, such as has been possessed by none of his predecessors in this high and important position. As the Hon. W. G. A. Ormsby-Gore, after serving as intelligence officer in the Arab Bureau and assistant political officer on the staff in the Middle East during the War of 1914–18, and holding several minor but important political appointments in the early years which followed the armistice, he became successively Under-Secretary of State for the Colonies, Postmaster-General, First Commissioner of Works and Secretary of State for the Colonies. In the office last named he brought to the problems of the colonial dependencies the firm conviction that scientific study and the application of the results of scientific research are essential to promote the prosperity of the Colonies themselves, and advance the interests and well-being of the inhabitants, whether European or indigenous.

Lord Harlech's acquaintance with conditions in the dependencies, gained by a personal inspection in most of them, was wider in range than that of any of his predecessors in office, and where Africa was concerned was reinforced by the detailed knowledge which had come with his experience as chairman of the East African Parliamentary Commission of 1924, and as the British representative on the Permanent Mandates Committee of the League of Nations. Lord Harlech's retirement from office after the death of his father in 1938, owing to his increased responsibilities, was felt by his colleagues and by all concerned with or interested in Colonial administration to be a great loss to the public service. His solicitude for the antiquities of England and Wales, and his services to British archæology while First Commissioner of Works, must be passed over here, but they are well known. Lord Harlech is an elected trustee of the British Museum and chairman of the governing body of the School of Oriental Studies in the University of London. He has also served as president of the Geographical Association and of Section E (Geography) of the British Association, as well as vice-president of the Museums Association.

Materials for Pest Control

IN 1937, several national industrial organizations, being impressed by the disturbing frequency of infestation of warehouses, granaries, mills and other structures of high capital value, and of ships, lighters, rolling stock, sacks and all other equipment essential to storage, process and transport, as well as by the heavy loss in value and destruction of foodstuffs, etc., set up an informal conference, under pledges of co-operation, with the object of establishing improved conditions. Infestation not being inherent in the commodities but being introduced in the links of the chain of trade, it was clearly essential to get

general agreement on concerted action. Where standards were low or absent, proof was not lacking that there was a constant injection of infested commodities into the trade stream. At the outset it was recognized that control of the condition of the country's imports would have to commence in the countries of export, and that the aid of Government was necessary. It was also recognized as a first essential in that direction that definite indication should be given that the house here was being put in order. The most important and easiest step was that ordinary principles of cleanliness should be inculcated. This could be achieved largely by the exercise of commercial prudence. The owner of the commodity and the owner of the structure or equipment could be more mindful of their duty to each other, and the force of competition could be used to raise standards. Restraint on landing and isolation of fouled commodities again were really matters of commercial prudence, but as the most desirable precautions, if left to voluntary effort, could be offset by the recalcitrant or indifferent, something more substantial than the play of commercial prudence was needed. There remained the respective parts of the applied biologist and the chemist. Control of infestation of stocks or structures necessitated prolonged research. In this respect it was fortunate for the conference that these very matters had for a long time past been the special preoccupation of the Stored Products Laboratory of the Imperial College of Science and Technology; although it was to be regretted that that work in more recent times had suffered greatly and been circumscribed by lack of recognition.

The conference laid its problem before the Government early in 1938, and by the end of that year, decision had been taken for the establishment of a permanent research and advisory organization under the Department of Scientific and Industrial Research, industry making substantial grants towards the cost. The Department accepted the generous offer of the Imperial College to place the Stored Products Laboratory at Slough available, and the new organization inherits the benefit of the past work of the laboratory. The Department also established the Standing Conference of Co-operating and Contributing Industrial Organisations, and appointed as its chairman Mr. W. McAuley Gracie, the chairman of the former informal conference and the initiator of the industrial effort. Prof. J. W. Munro, the former director of the laboratory, has become the consultant to the Department, whilst retaining his chair in the College. This desirable conjunction of science and industry was effected prior to, and the organization was available at, the outbreak of war. In the course of the industrial investigations it has become apparent that immediate attention should be given to the establishment of a comprehensive case for guidance in production, research and application as relating to insecticides, fungicides, raticides and repellents for all purposes. Several scientific advisers to and in Government Departments have been consulted, and they fully agree as to this. Certain sectional pieces of work have been done, and available information can be lifted out of dormancy, but there are gaps to be filled and a general harmony to be established, so that economic decisions may be taken and lines of research indicated. Mr. Gracie has requested Mr. W. V. Blewett, who has been released by Imperial Chemical Industries, Ltd., for this purpose, to carry out at once an economic and technical survey of the demand and production of these materials, with special reference to the potentialities and requirements of the British Empire and friendly States. Communications should be addressed to Mr. Blewett, at 42 Hamilton House, 155 Bishopsgate, London, E.C.2.

The Universities and Man-Power

At the annual meeting of the Court of Governors of the University of Birmingham, the Vice-Chancellor, Dr. Raymond Priestley, paid a tribute to the attitude of the Government in recognizing the importance of the part the universities can play in the war-time economy of Great Britain. This has been directed towards the avoidance of the waste of young men of high educational attainment and intellectual promise which was so lamentably characteristic of the War of 1914–18. Dr. Priestley regards this attitude as "one of the few signs of progress we can see in a backslidden generation". But in the last few weeks, things have taken a turn for the worse. In times of crisis, when the immediate needs fill the foreground, there is a real danger that we may take a too shortsighted view. The stream of science, and applied science, graduates has so far been undammed; the trouble here is the great increase in the demand. But Dr. Priestley wonders now whether we have been wise in diminishing the flow of graduates in commerce, art, and law. The Government clearly has not changed its university policy, and intends to safeguard the situation as well and as promptly as it can.

"The real menace to our future is the air training scheme. No one in his senses will grudge to the R.A.F. to-day the lion's share of the flower of the nation's youth. Nevertheless, this scheme, reaching, as it does, right down into the schools, is the real danger the universities face to-day. Its success is a measure of the essential soundness, the grit, the adventurous spirit and the imagination of British youth. But this does not decrease the universities' dilemma, as they foresee the loss of their raw material for 1942 and later war years. Some of these lads, outstanding in character and intellect, who are to-day flocking to the R.A.F., should be saved from their own enthusiasm. For the sake of the nation's future, they should be directed into the universities".

Government Grant to Universities

Speaking in reply to a question by Mr. K. W. M. Pickthorn (University of Cambridge), Sir Kingsley Wood, Chancellor of the Exchequer, recalled that, in view of the vital part played by the universities in the life of the community, the importance of maintaining so far as possible the standards of university education and the essential contribution which the universities are making in a variety of ways towards

the national effort, it was decided to maintain the provision for the current year at the same level as that of 1939, namely, £2,149,000. These considerations, he said, have lost none of their force, and despite the increasing strain on the national finances the Government, after considering a report from the University Grants Committee, have reached the conclusion that if the universities are to continue their present contribution to the national effort the provision for 1941 must be maintained at the existing level. He expressed the hope that local authorities will take similar action.

Precautions against Blister Gas Attacks

As a precautionary measure, which is being taken to cope with the possible use of blister gas by the enemy in aerial attacks on Great Britain, pharmacists are to be asked to provide supplies to the public of 'bleach cream'. The Ministry of Home Security, which has been in collaboration with the Pharmaceutical Society, is responsible for the scheme. Briefly, the Ministry has invited all proprietors of pharmacies, by a letter addressed to each one of them, to make 'bleach cream' available for members of the public in the event of blister gas being dropped in the vicinity of their pharmacies. The plan is quite simple; it is that the proprietor of each pharmacy, having been provided by the local authority with two enamel pails and a supply of 'tropical bleach' for the preparation of bleach cream, should, when and if gas is first used, place the pails furnished with cream on the pavement outside his shop with a poster instructing the public how to apply it. No charge would be made to the public, and it has been agreed with the Pharmaceutical Society that pharmacists should be asked to perform this service without payment as part of their contribution to the national effort.

An Ichthyosaurian Fossil

ACCORDING to a report published by the daily Press, a nearly complete skeleton of an Ichthyosaurian, or fish-shaped fossil reptile, has been found in the shaft of the Hermann Göring Mine in the northern Harz Mountains. It is to be studied by Prof. J. Weigelt, of Halle, who estimates its length as 5·10 metres, or nearly 17 feet. Such well-preserved large skeletons are very rare and difficult to extract from the rock in a perfect state. The largest Ichthyosaurian skeleton in the British Museum, which was obtained from the Lower Lias of Lyme Regis, Dorset, would measure about 24 feet in length when it was complete. Several known Ichthyosaurian skulls from the Lias belong to individuals which must have been at least 30–40 feet long. One of the finest of these large skulls, from Lyme Regis, is exhibited in the rooms of the Geological Society of London at Burlington House.

Classification of Ships and Machinery

THE Thomas Lowe Gray Lecture to the Institution of Mechanical Engineers on January 24 by Dr. S. F. Dorey was on the "Progress in Marine Engineering as Influenced by the Classification of Ships". The classification of ships sprang out of the ancient practice of marine insurance, and has been in vogue for nearly two centuries. There are many classification societies; but the best known is Lloyd's Register of Shipping of which Dr. Dorey is the chief engineer surveyor. These classification societies serve the interests of shipowners, shipbuilders, engineers, underwriters and others, and each of them has rules relating to the construction and maintenance of ships and their machinery. Giving a sketch of the development of marine machinery since the earliest steamboats, Dr. Dorey traced the rules by which Lloyd's Register has influenced progress. From the first specification for machinery, right through the period of its construction and at regular periods during its life, Lloyd's surveyors have duties to perform, and the whole shipping industry owes much to the impartial and exceptional way those duties are performed. From its very constitution a classification society is strictly impartial; it is a form of voluntary control of an industry by the industry for the general well-being.

Factory Canteens

THE Factory (Canteens) Order of the Minister of Labour, whereby all factories doing Government contract work and employing 250 persons are required to provide canteen facilities either in or near the workshops, has opened up new problems to the management of factories (*Electrician*, Jan. 17). In the first place, factory meals will, of necessity, be inexpensive, and of the various cooking processes involved, boiling and steaming will be in preponderance for such items of diet as stews, steamed puddings, rice and vegetables of various kinds. Ample steaming oven accommodation must therefore be made for the large quantities of steamed food, and steam boiling pans for greens, stews, etc. Electric cooking has the advantage that the air is not vitiated by the products of combustion, and ventilation problems are, therefore, usually less acute. The usual number of air changes per hour normally allowed for a kitchen is of the order of 20–60; this could be modified, depending on the provision for natural ventilation. In using electricity for thermostatically controlled instantaneous boilers to deliver water near boiling point, it is best to arrange that the demand occurs during the peak period of the load on the public power station.

Molybdenum and Tungsten in the Caucasus

IT is announced by "Russia Today" Press Service that large molybdenum and tungsten works have been opened recently in Kabardino-Balkaria, in the Caucasian mountains. The plant is situated at the foot of Mount Tyrny-Auz. Soviet geologists began to prospect for ores on this mountain in 1934. At an altitude of 9,850 ft. they discovered large deposits of rich molybdenum and tungsten ores. Owing to the situation of the Tyrny-Auz deposits, however, the extraction of the ores has presented a difficult problem, and local weather is severe. Everything about the workings is mechanized. The ore, which is extracted by means of electric drills, is brought away

from the face by electric trains, sent to the surface by conveyer belt and lowered to the works at the foot of the mountain by cable hoists. The ore mine has four electric power stations and a central air-compressing station. There is an electric sub-station underground. The nearest centre to the new works is Nalchik, capital of Kabardino-Balkaria.

Detection of Toxic Gases

We have received a copy of Leaflet No. 12, "Methods for the Detection of Toxic Gases in Industry: Organic Halogen Compounds" (H.M. Stationery Office, 1940. 2*d*. net). Ten substances are covered, including tetrachloroethane, pentachloroethane and carbon tetrachloride. One of the most toxic of the group is tetrachloroethane. The method of detection is by the use of a special lamp burning pure alcohol in a supply of the air under test. The halides are decomposed and react with a small copper screw in the nozzle of the lamp, giving a green coloration to the flame.

Marie-Alfred Cornu, For.Mem.R.S. (1841-1902)

On March 6 occurs the centenary of the birth of the distinguished French physicist, Marie-Alfred Cornu, who for thirty-five years held the chair of physics at the Ecole Polytechnique and who in 1896 was elected president of the Paris Academy of Sciences. Born at Chateauneuf, near Orleans, he had a brilliant career as a student at the Ecole Polytechnique and the Ecole des Mines, and was made a professor at the former at the age of twenty-six. His investigations carried out in the next ten or fifteen years raised him to the highest rank of experimentalists. Using Fizeau's methods he re-determined the velocity of light; with Baille, in the cellar of the Ecole Polytechnique, he re-determined the density of the earth, and among his memoirs of this time were some on the theory of electrostatics in which he explained the potential theory of Gauss and Green, then little known in France. His later work included valuable researches in spectroscopy. He was admitted a member of the Paris Academy of Sciences in 1878 as successor to A. C. Becquerel, and in the same year received the Lacaze Medal, and also the Rumford Medal of the Royal Society. In his own country he served on the Bureau des Longitudes, and as president of the International Commission of Weights and Measures. He was a foreign member of the Royal Society, and an associate of the Royal Astronomical Society. As Rede Lecturer at Cambridge in 1899, he discussed "The Wave Theory of Light and its Influence on Modern Physics". He was not only a successful experimentalist and a leader in scientific thought, but also a great teacher. He died on April 11, 1902. Three years later the French Physical Society struck a medal in his honour.

The Night Sky in March

The shortening night reaches equality with the day at the spring equinox, March 21d. 0h. U.T. The moon is full on March 13 and new on March 27. A partial lunar eclipse occurs at the full and an annular eclipse of the sun at the time of new moon, but both eclipses are invisible from Great Britain. A notable occultation takes place on March 5, when both the disappearance and reappearance of α Tauri (Aldebaran) can be favourably observed subject to weather. As seen from Greenwich, the disappearance of the star behind the moon's unilluminated edge (moon near first quarter) is at 19h. 16·1m. at position angle 108° from the north point of the moon's image; the subsequent reappearance is at 20h. 29·1m. at 242°. On March 8, λ Geminorum is also occulted, the disappearance seen from Greenwich being at 21h. 20·4m. at position angle 97° (Add 1 hour to all these times to read in Summer Time.)

Of the planets visible this month, Jupiter and its close companion, Saturn, are in the western sky at sunset; they are not far from the moon's slender crescent on March 3 and 30. Mars continues as an early morning star, in the constellation of Sagittarius. The planet is moving about 3 minutes of Right Ascension per day eastwards amongst the stars. Venus and Mercury are now stars of the dawn, being in conjunction with each other on March 3 at 13h. Mercury reaches greatest western elongation (28°) on March 25, but Venus is drawing towards the sun's place until superior conjunction on April 19. In mid-March, Sirius souths about 1 hour after sunset.

As night sets in, the bright stars of the familiar winter constellation are declining westwards. Amongst the less spectacular constellations east of the meridian is Coma Berenices. This constellation contains a loose cluster of stars which, about March 15, comes to the southern meridian at 2h. summer time at an altitude of 65°. East of this cluster is the position of the north galactic pole. A long-exposure photograph (200 minutes) taken with the 100-inch reflecting telescope at Mount Wilson "records fully as many recognizable nebulæ as stars" (Hubble). The farthest of these nebulæ recorded on the photograph are thought to be at an average distance of the order of 500 million light years. Thus in the general direction of the galactic poles—unobscured by the vast gas and dust clouds of our stellar system—we look out into remotest space.

Announcements

On medical advice, Sir Edwin Butler, formerly director of the Imperial Mycological Institute, has resigned from the secretaryship of the Agricultural Research Council.

Dr. Franz Verdoorn, editor of *Chronica Botanica*, has been appointed research associate in the Farlow Herbarium, Harvard University.

The Rockefeller Foundation has agreed to continue until the end of 1941 its grant of £1,200 a year for research in cellular physiology at the Molteno Institute, University of Cambridge, under the direction of Prof. D. Keilin.

In 1938 there were 15,111 cases of smallpox in the United States. Of these, 14,106 occurred in the States north of Ohio and west of Mississipi, where vaccination is not compulsory.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Action of Sulphonamides and their Derivatives on Bacteria

THE sulphonamides constitute a group of therapeutic agents of the highest importance in the treatment of disease, yet at the present time comparatively little is known concerning the precise nature of their mode of action upon micro-organisms in general. In this connexion Long and Bliss in their work "The Clinical and Experimental Use of Sulphanilamide, Sulphapyridine and Allied Compounds" quote: ". . . for the time being one must be content with the simple conception that these sulphonamido preparations inhibit the growth of susceptible micro-organisms in the body and in the test tube". In my investigations on the *in vitro* mode of action of sulphanilamide I have discovered a hitherto unknown yet easily demonstrable reaction which throws considerable light upon the mechanism of the anti-bacterial activity of this drug and renders it necessary to modify the above statement of Long and Bliss. In this preliminary communication I wish to place on record a brief summary of my researches during the last twelve months.

It is a well-known fact that the group of organisms exemplified by *B. subtilis*, *B. mycoides*, *B. megatherium*, *B. mesentericus* exhibit a pelliculous growth on the surface of the liquid culture medium. I have found that members of this group exhibit an abnormal behaviour in the presence of sulphanilamide and allied compounds of the sulphonamido type in as much as the pellicle formation is inhibited or completely suppressed. Concentrations of sulphanilamide of 1 : 100 to 1 : 3000 retard the rate of growth of *B. subtilis*, but even in the presence of this high concentration of the drug an excellent growth of the organisms develops after some time, although pellicle formation does not take place. In dilutions greater than 1 : 3000, sulphanilamide exerts no retarding influence on the rate of growth of the bacteria, but, in spite of the normal rate of growth, there is complete suppression of pellicle formation which persists down to dilutions of sulphanilamide as great as 1 : 50,000 to 1 : 100,000. As the dilution of the drug is increased beyond 1 : 100,000 there is observable a gradual development of pellicle. I have found, moreover, that the degree of inhibition of pellicle formation is strictly parallel with the degree of inhibition of spore formation. The inhibition and ultimate suppression of sporulation is indicative of a subnormal bacterial metabolism, and from this it must be inferred that the bacteria are living in an asthenic state. In addition, I have observed that the ability to inhibit and suppress pellicle formation is not limited to sulphanilamide alone, but is also possessed by a multitudinous number of diverse chemical compounds; in fact it is possessed in varying degree by all substances which exert an injurious effect upon the bacterial life.

Up to the present time it has been possible to demonstrate two types of anti-bacterial activity, namely, bactericidal and bacteristatic. However, it is now possible to extend this and render demonstrable in a precise yet simple manner a third state of anti-bacterial activity which I have designated a bacteriasthenicizing activity. Under the bacteriasthenicizing influence the bacterium exhibits a normal rate of growth but a subnormal metabolism, that is, the organism continues to live and grow in a state of bacteriasthenia.

It is a well-known fact that chemical change in the structure of the sulphanilamide molecule, such as the introduction of N_1 and N_4 substituents or modification of orientation of the amino and sulphonamido groups, changes in a precise and definite manner the *in vivo* anti-bacterial activity. By experimenting with all the well-known synthetics of the sulphonamido group I have found that in the same way alteration of the chemical structure of the sulphanilamide molecule is accompanied by a modification in the ability to inhibit pellicle formation of *B. subtilis* and, moreover, that this modification is strictly parallel with the modification of the *in vivo* anti-bacterial activity. This is demonstrated in the accompanying table.

Drug	*In vivo*	*B. subtilis* reaction
Sulphanilamide	Very active	Very active. Pellicle formation suppressed down to sulphanilamide concentration of 1 : 100,000
Sulphanilic acid	Slightly active	Slightly active. Pellicle formation suppressed only by concentrations of sulphanilic acid greater than 1 : 4000
N_4 acetyl-sulphanilamide	Inactive	Inactive. Good pellicle formation in concentrations of drug as high as 1 : 1000

All active compounds at present in therapeutic use, for example, sulphanilamide, albucid, sulphapyridine, soluseptazine, etc., are active in the new reaction, that is, they completely suppress pellicle formation down to dilutions of the drug of 1 : 50,000 to 1 : 100,000.

Moreover, it is a well-established fact that the anti-bacterial activity of sulphanilamide is inhibited by the presence of *p*-aminobenzoic acid both *in vitro* (Wood) and *in vivo* (Selbie). A parallel phenomenon is observable in the new reaction, namely, although high dilutions of sulphanilamide suppress pellicle formation, the addition of *p*-aminobenzoic acid enables copious pellicle formation to take place even in high concentrations of sulphanilamide.

The complete results of the researches outlined above, with results obtained *in vitro* in the presence of blood and serum, and together with observations on the bacteriasthenicizing activity of the blood and serum of patients undergoing sulphonamide therapy, will be shortly published.

M. MANDELBAUM.

Ward, Blenkinsop and Co., Ltd.,
Research Laboratories,
London and Liverpool
(formerly Director, Bacteriological and
Serological Institute.
Hospital Munchen-Schwabing,
Munich). Jan. 28.

Vitamin Content of Salmon

THE tables of the vitamin content of foods of Fixsen and Roscoe[1] are in constant use in assessing the vitamin value of diets. Our attention, however, has recently been directed particularly to salmon. The vitamin A concentration of body oil and flesh oil is there given as 4,400–52,500 and 0–20,480 international units per 100 gm., while the vitamin D concentration of flesh oil is listed as 9,500 international units per 100 gm., and the vitamin D content of salmon flesh at 200–800. The ascorbic acid content given is 89·9–215·6 mgm. per 100 gm. of flesh. These vitamin C figures are higher than any reported for oranges and lemons and equal those given for varieties of blackcurrant, noted for their anti-scorbutic properties. Taken together with a calorific content thrice that of orange juice, these values suggested that salmon might be regarded as deserving of precedence over the citrus fruits for import space.

Confirmation of these figures was desirable. Since most of the salmon eaten in Great Britain is tinned, twelve different brands were purchased in the open market, together with a chilled salmon weighing about 24 lb. This was kept in a cold store until a few minutes before the analyses were made. The accompanying table shows the results of the analyses on these.

Sample.	Vitamin A (blue value).	Vitamin B (I.U. per 100 gm.).	Vitamin C (mgm. per 100 gm.).
1. Alaskan	nil	10	nil
2. "	"	10	"
3. "	"	10	"
4. English (probably)	"	15	"
5. " "	"	11	"
6. " "	"	8	"
7. " "	"	11	"
8. Scottish (probably)	"	8	"
9. "	"	8	"
10. " "	"	10	"
11. 'Foreign'	"	8	"
12. Japanese	"	8	"
13. *Chilled Salmon.*			
a. Middle cut	nil	76	9
b. Tail cut	nil	86	9
c. Liver	860		10
d. Roe (hard)	30	190	21
e. Intestine	33	38	10
f. Pancreas	154	34	6
g. Heart			8
h. Gills	nil	nil	4

Vitamin A was determined by hydrolysis of the fish sample in methyl-alcoholic potash and measurement of the antimony trichloride 'blue value' calculated to a 20 per cent solution of the original sample on the non-saponifiable residue. No carotene was detected. Vitamin B_1 was determined by the thiochrome method; vitamin C by titration with 2·6 dichlorophenol indophenol.

A representative sample of the whole material from one of the tins listed above was assayed biologically on chicks by the B.S.I. standard radiographic technique for vitamin D_3. It gave a figure of 600 units per 100 gm. of flesh with fiducial limits at P = 0·95 of 83–119 per cent. This agrees with Fixsen and Roscoe's figure quoted.

From this work, it appears that, although fresh salmon may contain the large vitamin stores attributed to it, the material that reaches the table of the British housewife is far from being as rich in vitamins A and C as hitherto published figures would suggest.

Research Laboratories, Vitamins, Ltd., London, W.6. Jan. 16.

MAGNUS PYKE.
MARGARET D. WRIGHT.

[1] *Nutrition Abst. and Rev.*, **7**, 823 (1937–38); **9**, 795 (1939–40).

Weather, Wild Birds and Home-grown Food

THE effects of the severity of the winter of many years back on wild birds have been described by various writers from 1408 onwards, but coming to more recent times we have the comprehensive account given by James Hardy and others[1] for the winter of 1879–80, that of A. W. Preston[2] for 1890–91 and other references to the winter of 1894–95. Still more recently we have the excellent account by Jourdain and Witherby[3] of the disastrous effects of the winter of 1894–95, and finally the very full and valuable account of the effects of the particularly severe winter of 1939–40 given by Ticehurst and Witherby[4].

It is unnecessary here to detail the enormous reductions that have taken place in our wild bird fauna. They are very serious and the repercussions will be of a far-reaching nature.

Those interested in economic biology know what an enormous amount of home-grown food was destroyed by injurious insects and rodents in 1917 and 1918, and there seems no reason for supposing that any but similar conditions will prevail in 1941 and 1942, unless some wise and well thought out action is taken quickly.

Writing in 1918[5] I have pointed out that "All who take an interest in the ways and habits of wild animal life must have been struck by this curious coincidence—namely, during the spring and summer of 1917, very many of our commoner species of wild birds were apparently rare, and injurious insects and rodents were particularly abundant; during 1918 the same phenomenon was still more noticeable, the insects being exceedingly abundant, in many districts sufficiently numerous to constitute a plague. As a result of this dislocation of the so-called balance of nature an enormous amount of home-grown food has been lost".

To-day it is not enough for the farmer and fruit grower to grow abundant crops if such cannot be harvested clean and free from disease. Every year vast quantities of such food are destroyed by injurious insects and rodents, and this year and next, owing to the great reduction in our wild bird population, that amount will increase to an enormous extent, and although we are increasing the acreage cultivated, the sum total, in very many cases, instead of being more, will be less.

In view of the seriousness of the situation, I suggest that the destruction or taking of any wild birds or

their eggs in Great Britain and Northern Ireland from now until the end of 1942 (the following species excepted—house sparrow, starling and wood-pigeon) should be prohibited during 1941 and 1942, and the results of such action carefully reviewed and any further action considered at the end of 1942.

WALTER E. COLLINGE.

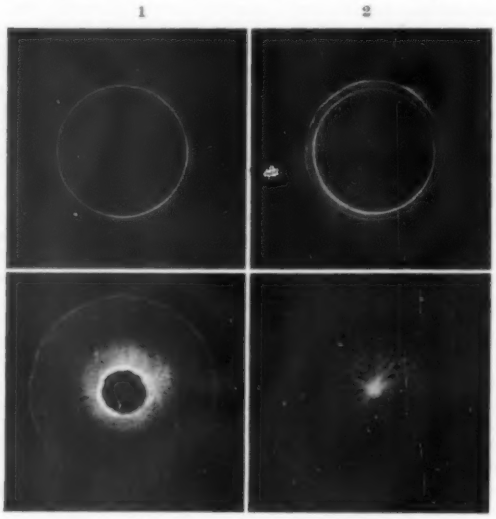
The Yorkshire Museum,
York. Jan. 21.

[1] *Proc. Berwickshire Nat. Club*, **9**, 304–572 (1881).
[2] *Trans. Norf. and Norw. Nat. Soc.*, **5**, 191–195.
[3] *Brit. Birds*, **11**, 266–271, and *ibid.*, **12**, 26–35 (1918).
[4] *Brit. Birds*, **34**, 118–132, and *ibid.*, 142–155 (1940).
[5] *National Review*, 234–239 (1918).

Conical Refraction in Naphthalene Crystals

THE birefringence of many organic crystals of the aromatic class is large, and when the intermediate index differs widely from the upper and lower indexes, the angles of internal and external conical refraction assume very high values. These angles in naphthalene, for example, are both about 13° 45′, which may be compared with 1° 54′ and 1° 44′ respectively in the classical case of aragonite. By fusion followed by very slow solidification, it is fairly easy to obtain transparent blocks of naphthalene and other aromatic compounds. When suitably cut and mounted between glass cover-slips, naphthalene crystals exhibit the phenomena of conical refraction in a very striking way, and enable their features to be critically examined.

The photographs reproduced with this note are the images of a fine illuminated pinhole held against the face of a naphthalene crystal 2 mm. thick and viewed through it in the appropriate direction. In the first of the series, the pinhole is seen in perfect focus and appears as a very sharp and perfect circle. The three other pictures illustrate the effect of moving the focus away from the pinhole, until, finally, in the last picture, the second surface of the crystal is in focus. The central bright spot seen in the fourth picture is actually an image[1] of the fine pinhole used, and appears at the point where the axis of single-ray velocity meets the rear surface. This bright spot continues to be the most conspicuous feature in the field for a great distance behind the crystal.



CONICAL REFRACTION IN NAPTHALENE CRYSTALS.

It will be seen on a comparison of the first and second pictures that, at least in the case of naphthalene, *the so-called Poggendorf dark circle vanishes when the pinhole is seen in perfect focus.*

C. V. RAMAN.
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Indian Institute of Science,
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Dec. 19.

[1] Raman, C. V., NATURE, **107**, 747 (1921), and *Phil. Mag.*, **43**, 510 (1922).

Temperature Dependence of Adiabatic Compressibility

IT is well known that the adiabatic compressibility β_φ of a liquid increases fairly rapidly with rise in temperature. The rise becomes more rapid as the temperature increases. With many liquids the adiabatic compressibility increases by about 60 per cent for a rise of temperature from 0° to 60°, or $\frac{1}{\sqrt{\beta_\varphi}}$ decreases by 21 per cent. A large part of the high initial compressibility of ordinary liquids is connected with the nearness of the critical point liquid gas, for compressibility in the gas phase is high and at the critical point itself compressibility is infinite[1]. Hence the absolute value of the compressibility depends on how far the temperature is from the critical point.

The characteristic frequency of vibration of molecules in a liquid is given by

$$\nu = S\left(\frac{3}{4\pi}\frac{N}{V}\right)^{1/3},$$

where S is the velocity of sound in the liquid and N and V are Avogadro's number and molar volume respectively[2];

$$\text{or } \nu = c\sqrt{\frac{V^{1/3}}{M\,\beta_\varphi}},$$

for a given liquid, where c is a constant and M the molecular weight.

In the light of the available data[3] on the compressibility of a number of liquids, the above expression has been examined in relation to its temperature variation, and it is found that the expression decreases linearly with temperature according to the relation

$$\sqrt{\frac{V^{1/3}}{M\,\beta_\varphi}} = k\,(\theta_c - \theta),$$

where θ_c is the critical temperature, θ is any temperature and k is a constant characteristic of the liquid. In the following table are given values of k for a number of liquids:

Liquid	k
Benzene	110·8
Carbon tetrachloride ..	77·5
Ether	121·8
Chlorobenzene	80·8
Toluene	92·6
Acetic acid	93·6

The expression does not hold for alcohols. It is also found that a fair estimate of the critical temperature can be made from the variation of the adiabatic compressibility with temperature.

Details will be published elsewhere.

M. RAMA RAO.

Department of Physics,
University of Mysore.
Oct. 20.

[1] Bridgman, *Rev. Mod. Phy.*, **7** (1935).
[2] Born and Karman, *Phys. Z.*, **14**, 15 (1913).
[3] Tyrer, *J. Chem. Soc.*, **105**, 2534 (1914).

Laws of Nuclear Structure Derived from Nuclear Spins

In 1935 and 1936 I directed attention[1] to a striking statistical property of atomic nuclear spins, namely, that the form of the distribution curve for spins of atoms with odd atomic weight depends upon whether the odd particle in the nucleus is a proton or a neutron. Since then, new and revised nuclear spin values have been reported for a number of atoms. The new distribution curves completely confirm the conclusions I then gave relating to the orbital and spin momenta of nuclear particles. Fig. 1 shows the new distribution for atoms with odd atomic number (odd nuclear proton) and Fig. 2 that for atoms with even atomic number (odd nuclear neutron). Shaded areas represent the number of atoms for which the reported spin values are doubtful but probable.

Nuclear spins are now known for eighteen pairs of isotopes in which both constituents have odd atomic weight. Eleven of these pairs (A) have odd atomic number (odd proton), the remaining seven pairs (B) having even atomic number (odd neutron). These isotope groups are:

GROUP A
Odd nuclear proton

Atom	Isotope	Spin
Cl	35, 37	5/2
K	39, 41	3/2
Cu	63, 65	3/2
Ga	69, 71	3/2
Br	79, 81	3/2
Ag	107, 109	1/2
Sb	121, 123	5/2
Eu	151, 153	5/2
Re	185, 187	5/2
Tl	203, 205	1/2
Rb	85, 87	5/2, 3/2

GROUP B
Odd nuclear neutron

Atom	Isotope	Spin
Mo	95, 97	1/2
Cd	111, 113	1/2
Sn	117, 119	1/2
Ba	135, 137	3/2
Xe	129, 131	1/2, 3/2
Yb	171, 173	1/2, 5/2
Hg	199, 201	1/2, 3/2

It will be noticed from these that there is another striking difference in distribution depending upon the nature of the odd particle. Apart from rubidium, *all* the members of group A have the *same* spin for both constituent isotopes. On the other hand, three out of the seven pairs in group B have *different* spins for the two isotopes, the heavier isotope having a greater spin. The exception, rubidium, is of particular interest, for the isotope 87 is radioactive and this is very likely to be the cause of the deviation.

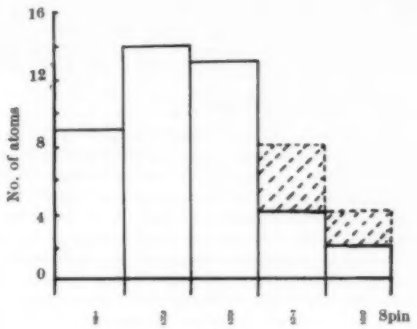

Fig. 1.
Odd proton.

In all these isotopic pairs the heavier constituent is formed from the lighter by the addition of a pair of neutrons. Both the curves and the additional data just given afford indirect support for Landé's odd particle theory of nuclear spin.

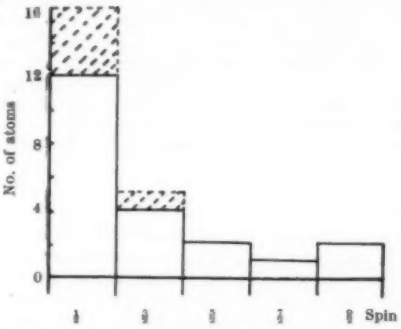

Fig. 2.
Odd neutron.

Three laws for nuclear structure can therefore be derived for stable odd atomic weight atoms:

(1) In stable atomic nuclei with an odd nuclear *neutron*, the spin and angular momenta of the lightly bound or odd particle(s) tend to *oppose* each other[1].

(2) In stable atomic nuclei with an odd nuclear *proton*, the addition of two neutrons does *not* alter the nuclear spin.

(3) In stable atomic nuclei with an odd nuclear *neutron*, the addition of two neutrons *may* increase the nuclear spin.

As a corollary to (2), it may be considered that when two neutrons are added in the presence of an odd proton, the neutrons set themselves with their spins in opposition.

S. TOLANSKY.

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University, Manchester.
Jan. 6.

[1] S. Tolansky, NATURE, **137**, 1071 (1936).

RESEARCH ITEMS

Bronze Head from Ifé, Nigeria

THE British Museum has recently acquired through the good offices of the National Art Collections Fund an example of the remarkable realistic art of Ifé, Southern Nigeria, in the form of a bronze head. This region of Southern Nigeria, which has long been known as the religious and cultural centre of the Yoruba people, possesses an ancient tradition of artistic accomplishment of a high order. It is distinguished by its realism from the generality of Negro sculpture, which is better displayed in diverse simplifications and conventionalizations of the human form than in strict fidelity to Nature. Hitherto, Ifé art has been represented in the British Museum only by a single original in the form of a terra-cotta head. In recent years a number of examples of the bronze heads have been found during building operations at Ifé, while the late Leo Frobenius collected several of the terra-cottas in 1911–12. In describing the British Museum acquisition, H. J. Braunholtz (*Brit. Mus. Quarterly*, **14**, 4; 1940) states it is of exceptional ethnographic and æsthetic interest. It has evidently been cast by the *cire perdue* process and is now patinated to a green tint, though showing traces of red paint on the headdress, possibly a relic of painting of the whole. Parallel lines on the face represent a form of scarification still practised. Small holes surrounding the mouth and extending to the ears presumably were intended for the insertion of hair or other material to represent a beard and moustache. In vitality and sensitive modelling, it bears comparison with the finest sculpture of other times and countries. In date it can scarcely be later than the sixteenth century, when the art of Benin reached its highest peak.

Reproduction of Trout in New Zealand

A WIDE collection of material from sixty-four streams in ten river systems in the North and South Islands has enabled Derisley F. Hobbs to reach reasonably sound conclusions regarding the natural reproduction of the introduced brown trout (*Salmo trutta*) and rainbow trout (*S. irideus*) in New Zealand (*Fisheries Bull.*, No. 8, New Zealand Marine Dept., Wellington: Gov. Printer, 1940. 3*s.*). The conditions required by trout for spawning are very special, and are to be found in restricted areas even in streams with beds predominantly of gravel. The result is that all the suitable sites are used for redds by early spawners, and late spawners, rather than spawn in unsatisfactory materials, make use of already occupied sites. Mortality therefore arises from the actual displacement of the earlier eggs, or from the deposition of silt upon the earlier eggs by the later activities, for heavy losses in redds were found to be associated with the presence of excessive quantities of fine silty matter. The extent of losses caused by superposition of redds has not been measured, but apart from that, losses are extremely small in the majority of redds. Deaths before hatching vary from 3·20 to 12·86 per cent, with one extreme case of 29·29 per cent. Between the time of hatching and the emergence of the fry from the redds, the death-rate is exceedingly low; in only one of nine river systems did it exceed 1 per cent. The author discusses in a hypothetical way the question of optimum density and exploitable excess in these natural populations; but the validity from the practical point of view of the angler or fish conservator of such conclusions as he reaches is likely to be overshadowed by natural fluctuations and environmental influences generally.

Flight of an Insect

UNDER the title of "The Flight of a Dipterous Fly *Muscina stabulans* Fallen", F. S. G. Hollick of the Zoological Laboratory, Cambridge, describes the results of his investigations (*Phil. Trans. Roy. Soc.*, B, **230**; 1940). As a preliminary, a comparison was made between the flight system with the insect held stationary and in normal free flight, and the relationship of one to the other established. The resultant of those forces, which by action on the insect's body maintain or change its state of motion during flight, was taken as the criterion for comparison. The author exposed the insect, held stationary, to a stream of air in a wind tunnel and states that there are good grounds for believing that such a method is suitable for the further study of flight. By recording photographically the amplitude of the wing-beat for ten individuals inclined at 0°–45° to air flows ranging from 0 to 320 cm. per second, it was shown that the amplitude decreased with increasing air speed and inclination of the body axis. A study of the path travelled by the wing relative to the insect shows that when the insect is exposed to a stream of air the course of the downward beat is displaced forwards, so as to convert the elliptical track characteristic of wing movement in 'still air', into the figure of eight path, commonly associated with insect flight. This change of path traversed by the wings was found to be dependent upon the movement or position of the third antennal joint relative to the second joint, resulting from the action of the stream of air on the third joint and the arista. The usual flight attitude of the legs and the continued maintenance of wing vibrations when air was blown on the insect from in front, were also found to be dependent upon the integrity of this system. In the appendixes the author describes his method of mounting living insects for experiment, together with the design of an aerodynamic balance and that of a small wind tunnel.

Caytonia: A Gymnosperm

T. M. HARRIS has redescribed the fruits of Caytonia from the material in the Wonnacott Collection in the British Museum (*Ann. Bot.*, N.S. **4**, October 1940). As a result, *Gristhorpia nathorsti* is renamed *Caytonia Gristhorpi*, and further support is given for associating all three species of Caytonia with foliage of species of Sagenopteris. In his original account, Hamshaw Thomas described the fruits as curved structures terminating in a lip on the adaxial side, which was termed a stigma. Harris has now found pollen in the micropyles of fifteen specimens of *C. sewardi* and sixteen of *C. nathorsti*, and concludes that the lip in life must have bordered a slit through which the pollen could enter the structure, so that the pollination was definitely gymnospermous in character. This necessitates a mechanism by which the pollen

is directed from the lip to the micropyle, particularly as pollen is not found freely in the cavity of the fruit. The state of preservation makes the solution of this problem difficult, but Harris points out that the peculiar barred structure of the mouth may result from the obliteration of converging canals running from the ovules to the mouth, and along which some 'pollination drop' mechanism may have conveyed the pollen. Harris concludes that Caytonia is a megasporophyll with pinnate branching, the pinnæ bearing ovules on their uncurved adaxial surfaces. This coincides with Thomas's first analysis of the structure: the later attempts to homologize the megasporophyll segments with carpels, or with the 'cupules' of the Corystospermaceæ, are deprecated.

Cross-lamination in Sandstones

A STUDY based on statistical analysis of cross-lamination in four Palæozoic sandstone units in northern Arizona—one of marine, two of deltaic and one of æolian origin—has been made by E. D. McKee, whose results are now published (*Amer. J. Sci.*, **238**, 811–824; 1940). In the Tapeats sandstone (Lower Cambrian marine) the type of cross-lamination pattern consists of repeated layers, each containing series of short, uniformly sloping, laminæ truncated by flat surfaces above and below, and suggests a sinking basin in front of a delta. In the Supai formations (Permian deltaic) the beds are characterized by a series of sloping, even, lamination surfaces which dip uniformly from top almost to bottom, suggesting development on the advancing fronts of small local deltas. Comparable structures have been observed by the author over large areas of the present-day Colorado River delta. In the upper Supai sediments individual sets of sloping laminæ terminate laterally by interference from other sets and the resulting patterns resemble 'compound foreset bedding' due to interference of adjacent lobes. In the Conconino sandstone (Permian æolian) the structure consists of sloping truncated wedges and is devoid of flat-lying or horizontal layers such as characterize the formations mentioned above. Moreover, the maximum dip (33°) is higher than that of the others, and some of the low-angle slopes show a direction reverse to the normal, indicating depositional or erosion surfaces on the windward side of the dunes. The data collected also serve to determine the different directions of transportation among the various types of sediments considered.

Fermentation of Ceylon Tea

THE term 'fermentation' is understood in the tea industry to mean the enzymic process during which 'black tea' develops its aroma and colour. After harvesting, the partly dried leaf is broken up in a rolling machine, whereby some of the juices are worked out from the leaf and form a varnish-like coating on the surface. This rolling or crushing starts fermentation which may be allowed to continue for several hours. The initial green colour of the crushed leaf changes during this time to a coppery-red tint. The tea is then dried, cleaned and graded. It has been known for some time that this fermentation involves oxidation of polyphenols in which oxidases, peroxidases and catalases are concerned. The substrates include tannins, catechins and polyphenols (catechol, gallic acid) so that the whole process is very complex. Since tea leaf contains a much higher amount of polyphenolic substances than is usual in plant tissues, it would not be surprising if it contained also enzyme systems with rather specialized functions. J. Lamb and H. B. Sreerangacher (*Biochem. J.*, **34**, 1472; 1940) now show that tea leaf preparations show marked specificity in the oxidation of ortho-dihydric polyphenols, without the activation of peroxidase, the primary oxidation products being probably orthoquinones. The system possesses the power of forming aniloquinones in the presence of quantities of potassium cyanide which are known to inhibit peroxidase activity. The system may be a parallel to the ascorbic acid - ascorbic oxidase and the cytochrome C - cytochrome oxidase systems in other plants, where a specific oxidase catalyses the initial changes of a series of reactions.

X-rays and Enzymes

IT has usually been thought that X- and γ-rays only influence enzymes when the dose is enormous, that cell division is inhibited by doses which have little or no destructive action on enzymes, and that, therefore, this inhibition is produced by a process in which enzymes play no important part. It has recently been found by W. M. Dale (*Biochem. J.*, **34**, 1367; 1940) that purified carboxypeptidase and polyphenoloxidase in low concentration are indeed affected by radiation in small doses. The percentage inactivation of these enzymes is a function of the enzyme for a given dose of radiation. Absorption of a definite amount of radiation energy corresponds to a constant amount of enzyme inactivated. Inactivation of carboxypeptidase does not take place when the enzyme is acting on its substrate during irradiation, whereas the enzyme irradiated without its substrate is inactivated to 85 per cent. This, if it can be generalized, furnishes an explanation of the so-called delayed action of X-rays in the sense that the reserves of unused enzyme in the cell are inactivated by radiation, whereas that part of the enzyme already in action remains unaffected by radiation.

Structure of Multilayers

X-RAY and microscopic examinations of multilayers of some long-chain esters have been made by G. Knott, J. H. Schulman and A. F. Wells (*Proc. Roy. Soc.*, A, **176**, 534–42; 1940). In order that microscopic examination could be made by transmitted light, the deposits were made on transparent bases such as celluloid, cellulose acetate, 'Perspex', 'Polystyrene', 'Formvar', vinyl acetates and other synthetic resins. Between crossed nicols, the individual crystals extinguished perfectly, showing that the molecules are arranged in some regular way from the base of the multilayer to the surface. The grain boundaries seen on the surface are therefore those of single crystals which have grown without interruption through the entire thickness of the multilayer. The same type of X-ray photograph was got from a stationary multilayer of ethyl stearate as from a single crystal of β-ethyl stearate rotated about the long axis of the cell. The 'spots' observed on oscillation photographs of multilayers of ethyl stearate taken in earlier work proved to be parts of circles, successive arcs of which appear on increasing the angle of incidence of the X-ray beam on the multilayer. It is concluded that the multilayers consist of microcrystals all oriented with a common axis normal to the surface. The single crystals were about 1,000 molecules thick in this investigation.

SOCIOLOGICAL ASPECTS OF EVACUATION

THE cross-section of our social life revealed in the stimulating and instructive report* of Mr. Geoffrey Shakespeare's committee on conditions in reception areas, does more than give a clear picture of the problems arising out of a sudden and extensive redistribution of the population and of the possibilities for good and ill innate in that process. It shows convincingly the way in which evacuation and education are linked with many other phases of our war-effort and with plans for reconstruction after the War. Again and again the efficiency of our war-effort in some particular field is powerfully affected by conditions in an apparently remote field. Adoption of many of the Committee's admirable suggestions is accordingly as much to be desired from the point of view of war-production or reconstruction as from that of educational or social welfare, and it is satisfactory to learn that most of them are being acted upon by the Ministry of Health.

A pertinent example is to be found in the matter of billeting. Much trouble is caused by the conflict between civilian and military billeting, and the report insists that there should be closer co-operation between all branches of the services and with the regional authorities. Periodical conferences between all billeting and quartering authorities and representatives of the Ministry of Labour are recommended. If the agreements reached are broken or points of dispute arise, the question should be referred for settlement by the regional commissioner and the senior military or air force officer in the region concerned.

It should not be forgotten, moreover, that this question of billeting impinges on that of man-power and production. The dispersal of factories on war-production, no less than the training of new labour and increasing the mobility of workers, particularly the skilled workers essential to the development of our full effort in production, will in itself make demands for billeting which must be co-ordinated with those arising out of evacuation, military or air force needs, if competiton and undesirable stresses and strains are not to occur. Furthermore, it may be necessary in some areas to exercise the Government's powers not merely to ensure that there is no evasion by well-to-do persons in the provision of billets, but also to see that unofficial and uncontrolled immigration into a reception area by those unable or unwilling to play their part in the national effort does not impede national and official schemes. Such instances may be rare, but failure to deal with them firmly can have far-reaching consequences.

An allied matter is the requisitioning of premises. Here, again, there is need for fuller co-operation. Adequate welfare arrangements depend on the availability of suitable premises, and while amenities for soldiers are very desirable, it is not right that all suitable premises should be so used to the detriment of evacuees. This, the report suggests, is not a matter always to be achieved locally, and to liberate premises for welfare purposes regular conferences between the regional commissioners and the service liaison officers are recommended. There are also complaints that many large houses have been earmarked by Government departments but are not being used, and a review of those not in use is also recommended. More drastic use of the powers of requisitioning by the Ministry of Health is recommended, particularly in regard to requisitioning of parts of occupied houses for welfare or other purposes, as well as fuller co-operation by educational authorities in the use of school premises for welfare purposes, both after school hours each day and during the week-ends.

The report displays an admirable grasp of all sides of the problem, and it emphasizes the importance of easing the burden of billeting in the reception areas, to secure which is one of the purposes of its recommendation for more drastic use of requisitioning powers by the Ministry of Health. More often than not, billeting officers have difficulty in placing new arrivals at once, and the provision of a larger number of buffer hostels is recommended for new arrivals as well as those who for any reason desire to change or should change their billet, and also to relieve the burden falling on householders. The desirability of such hostels is only one of many reasons why the best and fullest use should be made of all accommodation. The report visualizes the application of requisitioning powers in particular to parts of occupied houses, and even to stored furniture required for equipping homes or hostels.

There is, however, yet another way in which the growing demands for man-power and woman-power enhance the importance of the wisest use of available accommodation, and of the pooling of equipment, as well as accommodation, that are involved in this vast redistribution of the population. The increasing shortage of domestic labour and the insistent call for women to enter industry, as well as to leave their homes and join one of the auxiliary services of the forces or assist in the myriad activities organized by the Women's Voluntary Service, make it increasingly difficult for some housewives to respond to the demand for private billeting. The situations which will arise may well require careful handling if the development of our war effort is not to be impeded, or the door opened to what in war-time can only be described as evasion or malingering.

Much stress is laid in the report upon welfare. The provision of communal welfare services is regarded as the essence of success. Specific recommendations include the provision of mothers' clubs with communal feeding, nursery centres, arrangements for occupation for mothers, communal bath houses and laundry facilities, and week-end hostels where husbands can stay when visiting their wives. Attention to such matters has already proved a brilliant success in certain areas; but the execution of this policy involves the immediate appointment of a large number of welfare officers to encourage and supervise the formation of such facilities. In particular, the appointment of more welfare officers who understand the psychology of London mothers is required.

The provision of such welfare officers is probably one of the major difficulties. The report itself refers to a shortage of women of a suitable type for appointment as welfare officers, and with the simultaneous and growing demand from industry for welfare workers, largely stimulated by the Minister of Labour and National Service, it is difficult to see where the

* Report on Conditions in Reception Areas. By a Committee under the Chairmanship of Mr. Geoffrey Shakespeare, M.P. Pp. 18. (London: H.M. Stationery Office, 1941). 3d. net.

supply is to be obtained. Here, indeed, may be a matter in which the National Register might be utilized with advantage and a scheme of co-operation or control in making the appointments may well be essential, especially when it is remembered that welfare work is assuming increasing importance in the sphere of civil defence. The necessity for an examination and comb-out in the women's services if we are to make full use of trained personnel was well shown in the examples cited by Miss Ward in her speech in the debate on Production, Supply and Man-power in the House of Commons on January 21.

Once again the report makes plain the inherent possibilities which may emerge from the complications caused by this redistribution of population, and its references to these possibilities are among the most interesting parts of the report. Country life is proving of the greatest value to the bodies and minds of town children, and it may be hoped that the new understanding of the country, and surprising interest in all rural pursuits may be shared by their parents sufficiently to help to secure a more balanced national economy. The new amenities and departures in social welfare now being established in the reception areas may have their own influence in arresting the drift from the country to the town if the nation can continue such experiments after the war.

If such hopes are to be realized, there must, indeed, be a fuller understanding by the countryman or woman and the townsman or woman of each other's sentiments, habits and outlook, the absence of which did much to wreck the evacuation scheme in 1939. While the Committee seems surprisingly satisfied with the success of the subsequent evacuation, it is clear that a large number of the evacuees have settled down happily in the reception areas, and that in the great majority of cases the experiment is succeeding, particularly with the unaccompanied children. The extent of the migration is sufficiently indicated by the 25 per cent increase in the population of the reception areas visited by the Committee during the first year of the War, exclusive of the large number of service personnel stationed in them, in contrast with a decline of more than 10 per cent in the year before the War. Two-thirds of this increase has been due to unorganized evacuation—the arrival, without notice, of more than a million people, many of the priority groups, who have since been billeted—and in the face of these figures the amount of confusion and friction, both of which are diminishing, is surprisingly small.

The mingling of town and country, the engendering of mutual understanding, of goodwill and good behaviour on both sides, encouraged as they have been by the ordeals of the last nine months, may well prove a solid asset when the need for evacuation is past. The suggestions and recommendations of the Committee, based on the experience gained, are designed to diminish the strains or friction set up and to promote fuller understanding as well as morale. They are not, indeed, novel. Many of the remedies have been frequently urged unofficially before—for example, in the reports of the evacuation committee of the Association of Architects, Surveyors and Technical Assistants, and of the Department of Social Science of the University of Liverpool.

Their official reiteration is none the less useful on that account, and has already had effect in regard to co-ordination in billeting and in the steps already taken to stop the dispatch of official parties to areas believed to be saturated, a position which has been reached already in certain districts more readily accessible from London.

The recommendations in regard to the immediate adaptation of emergency premises earmarked for the treatment of epidemics and the greater provision of premises for infectious diseases, for the wider extension of the district medical service and for the extension of the voluntary hospitals contributory scheme, where possible, to evacuees in the reception areas, are equally important. So, too, is the recommendation that careful watch should be kept on water-supply, sanitation and sewage disposal, where the influx of population has proved their inadequacy. Still more significant, however, is the reliance placed by the Committee on the regional machinery for giving effect to its recommendations. A wider use of regional powers originally, instead of giving large and drastic powers to the local authorities, which they were reluctant to use, might have avoided much unnecessary friction. The whole trend of the report in this respect is an answer to the severest criticism of evacuation contained in the Evacuation Survey report to the Fabian Society, edited by R. Padley and Margaret Cole, and it may well prove that adoption of the Committee's recommendations will give a further impulse to regionalism in Great Britain, and the handling of social problems on regional rather than local lines.

GRAVITY ANOMALIES AND THE EARTH'S FIGURE

THE literature on this subject is so voluminous and scattered, in many cases in periodicals that are not easily accessible, that a publication such as that by B. L. Gulatee*, which provides an introduction to the fundamental problems, with special reference to investigations developed in recent years and to practical applications, is likely to be welcomed by a wide circle of readers. Chapter i deals with the various gravity formulæ and gives brief proofs. The practical derivation of the empirical formulæ is reviewed in Chapter ii. Gravity observations and arc measurements show that a triaxial ellipsoid fits the geoid better than a spheroid; but it is pointed out that the ellipticity of the geoidal equator is not yet indisputably proved. The observations have been made only on limited portions of the globe, and until more gravity determinations are made in suitable areas the question will remain open.

Chapter iii gives an account of Clairaut's, Darwin's and de Sitter's theories of the figure of the earth. Certain objections are pointed out and reference is made to the more recent work of Jeffreys, in which he draws inferences from the moon's motion and so avoids the necessity of making any hypothesis about the internal state of the earth. In Chapter iv, which deals with gravity anomalies, a useful summary is given illustrating the application of such anomalies

* Gravity Anomalies and the Figure of the Earth. By B. L. Gulatee. Pp. viii+116+10 figs. (Survey of India, Prof. Pap. 30, Dehra Dun, 1940.) R.3 or 5s. net.

to the elucidation of the geological structure and history of those regions where they have been specially studied.

No matter what hypothesis of compensation is adopted, considerable anomalies persist in certain regions, examples of which are Peninsular India, the Ferghana Basin, Japan, the Dutch East Indies, the Caucasus, the Caribbean Sea, many oceanic deeps and islands, and the African Rift Valleys.

Regions of large positive anomalies, being areas of overload, should be expected to be continuously sinking. A notable exception is provided by the island of Cyprus, which has risen, despite its positive anomalies. Such evidence, like that of the 'negative belt' around the Dutch East Indies, provides evidence of phenomena going on inside or below the earth's crust. Another application of gravity anomalies is the derivation of the form of the geoid; this is discussed in Chapter v. Finally, in Chapter vi, the various types of reference surfaces are defined and it is shown that it is necessary to distinguish a triangulation reference spheroid from one based on gravity measurements.

For convenience the diagrams have been placed all together at the end of the book on two double pages, so that they can be opened and seen clear of the text. A list of symbols is given for easy reference. If a second edition be called for, as seems likely, it might usefully be provided with an index.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Monday, March 3

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Dr. N. A. Mackintosh: "The Last Cruise of R.R.S. *Discovery II*".

Tuesday, March 4

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. H. A. R. Gibb: "Egypt".*

Thursday, March 6

LINNEAN SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—General Meeting.

Saturday, March 8

GEOLOGISTS' ASSOCIATION (at the Imperial College of Science and Technology, Prince Consort Road, London, S.W.7), at 3 p.m.—Annual General Meeting. Mr. W. P. D. Stebbing: "The Early Use of Subsoils in Farming, and the Farmer and his Instructors before William Smith".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

CHIEF ASSISTANT FOR HIGHER EDUCATION—The Director of Education, Town Hall, Bradford (endorsed 'Chief Assistant for Higher Education') (March 7).

LECTURER IN MECHANICAL ENGINEERING—The Principal, College of Technology and Commerce, Leicester (March 8).

HEADMASTER of the Sunderland Junior Technical School—The Director of Education, Education Offices, 15 John Street, Sunderland (March 10).

CIVIL ENGINEERING ASSISTANT to the River Ouse (Yorks.) Catchment Board—The Clerk to the River Ouse Catchment Board, 7 Langcliffe Avenue, Harrogate (endorsed 'Engineering Assistant') (March 10).

REGISTRAR of University College, Southampton—The Registrar, University College, Southampton (March 18).

HEAD OF THE SCHOOL OF TEXTILES—The Principal, College of Technology and Commerce, Leicester (March 24).

TENNENT PROFESSOR OF OPHTHALMOLOGY—The Acting Secretary of University Court, University, Glasgow (May 1).

GRADUATE IN ENGINEERING SUBJECTS—The Principal, Dursley Technical Institute, Dursley, Glos.

LECTURER IN THE MECHANICAL ENGINEERING DEPARTMENT—The Clerk to the Governors, Technical College, Chesterfield.

ASSISTANT ENGINEER for the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9306).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

John Innes Leaflet No. 4: The Fertility Rules in Fruit Planting. Pp. 8. (London: John Innes Horticultural Institution.) 6*d*. [161

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